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FINAL REPORT

FOR

DEVELOPMENT G. AN ENVIRONMENTALLY IMMUNE ELECTROSTATIC INSENSITIVE APOLLO STANDARD INITIATOR

NAS9-4147

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I <u>ABSTRACT</u>

As a result of the excellent static discharge resistance of the Apollo Standard Initiator at a one (1) atmosphere condition and considering the potentially high static electrofication possibilities of spacecraft, Space Ordnance proposed that a development program to provide the same level of electro-static discharge protection in deep space be conducted.

In addition, the intent of the program was to develop test techniques which will assure that the electro-static discharge will not degrade the initiation mix.

Four (4) of the seven (7) initially proposed concepts have shown that additional protection with respect to inadvertant firing as a result of high static voltage pulses, has been increased. However, none of these concepts have provided protection with respect to changes in interbridge characteristics of the initiation mix. All post-pulse electrical tests were conducted at sea level conditions.

General testing with respect to various electro-static pulse tests on initiation charge pellets outside of the initiator has been conducted, and a considerable amount of additional information in this area has been obtained. (Refer to General Testing Section of this report.)

II <u>INTRODUCTION</u>

An environmentally immune electrostatic insensitive Apollo Standard Initiator is being developed under NASA Contract No. NAS9-4147, under the cognizance of the NASA Manned Spacecraft Center, Houston, Texas.

Six design concepts have been tested for static discharge susceptibility at standard pressure and temperature and at a vacuum of 10⁻⁶ torr.

The goal of this program is to achieve a design that will not change electrical characteristics or fire inadvertantly as a result of static discharge from a 500 pico-farad capacitor charged to 30,000 volts dc whether at a sea level environment or in outer space.

Two basic methods have been evaluated:

- The encapsulation of a spark gap in a controlled atmosphere
- 2. The use of solid state techniques

III <u>CONCLUSIONS</u>

Testing conducted under this program has shown that both solid state and spark gap encapsulation techniques do provide environmentally immune electrostatic discharge properties.

Testing completed on six (6) concepts, three (3) utilizing encapsulation techniques, one (1) utilizing solid state techniques, one (1) utilizing an internal faraday shield, and one (1) utilizing an encapsulated spark gap in conjunction with the internal faraday shield produced the following results.

Each of the spark gap encapsulation methods improved the high voltage withstanding properties in one atmosphere and deep space environments. Solid state techniques utilizing General Electric Thyrite Varistor material also produced positive results with respect to high voltage withstanding capabilities; however, varistor materials which will meet the insulation resistance and dielectric strength requirements of the initiator are not available.

Units utilizing the internal faraday shield, and a spark gap in conjunction with a faraday shield produced negative results and no further consideration of these concepts are recommended.

Although spark gap encapsulation and solid state techniques do improve voltage withstanding capabilities, no method

tested provided protection with respect to changes in interbridge resistance and capacitance.

As a result of the negative data, with respect to interbridge characteristic changes, testing was conducted in the following areas:

- 1. Spark gap breakdown reproducibility.
- 2. Surge voltages.
- 3. Initiation charge pellet investigation.

Spark gap investigations showed that a given gap produced voltage breakdown levels which varied a maximum of plus or minus twenty percent.

Testing has shown that surge voltages are present at the initiation charge side of the header. This condition was demonstrated by providing one spark gap on a pin header assembly on the connector end and recording voltage differentials between the pin with the spark gap and the pin without. ferential of 500 to 550 volts was indicated. Efforts to record these surge voltages across an initiator spark gap were unsuccessful due to required recording speed and different breakdown times. As a result, no test data in this area is available. ever, it is reasonable to assume that if 500 volt surges are experienced on units with very small spark gaps, surges approaching the applied voltage are possible on units with a larger spark gap. Therefore, breakdown voltages seen during static pulsing are not indicative of what the initiation charge pellet is seeing.

Testing has shown that a pellet of initiation charge, when supported between two sharp .03 radii probes, looses its resistance characteristics when pulsed at voltage levels of 300 to 500 VDC. Testing following slight movements of the pellet, thereby changing the point of contact, which has changed its resistance characteristics have produced resistance readings of a non-pulsed pellet. This data verifies that the indicated changes are only with respect to a minute path through the pellet and is not indicative of an overall change in the pellet resistance.

Tests were conducted to determine which element of the SOS-108 mix was being affected. This was accomplished by blending special mixes omitting specified elements in each mix. Testing indicated that no single element is being affected and that the experienced changes occurred only on the complete composition.

Testing was conducted utilizing four (4) neon bulbs in series with each of the firing leads. These bulbs ionized and passed voltage to ground at between 70 and 100 volts. Units tested still evidenced changes in interbridge characteristics. However, after short periods at laboratory ambient conditions, interbridge characteristics returned to their original state.

In an effort to reduce voltage surges, choke coils were installed in series with each circuit. Units tested in this manner changed characteristics as before.

Investigations, with respect to methods of restoring interbridge characteristics, have been conducted. Initial results indicated that interbridge characteristics were restored to original state after being subjected to a temperature of 300°F. ial results were obtained after the unit had been removed from the heating chamber and stabilized at room temperature. Subsequent testing has negated initial results. unit which had not been electrostatically pulsed, AIRME reading of less than 1.00 circuit to circuit, was placed in the temperature chamber at 300°F. Interbridge characteristics were monitored as the units' temperature increased. After approximately five minutes, the resistance circuit to circuit was +4.0. Upon cooling, this reading reduced to its original level. This testing was also conducted on pulsed units. Interbridge characteristics on these units returned to less than 1.00 after approximately one minute in the temperature chamber. However, after approximately two minutes, the interbridge characteristics were again greater than 1.00. When allowed to cool, these characteristics returned to less than 1.00.

Testing has shown that the phenomenon of interbridge resistance and capacitance changes are, most likely, a result of any one or a combination of the following:

- A. Current flow through the mix.
- B. As a result of current flow and the associated heat, a localized change in mix structure occurs.
- C. A dielectric puncture of the binder.
- D. A sensitizing or polarization of the metal particles.

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IV RECOMMENDATIONS

Testing conducted on this program has shown that a number of the concepts tested will provide high voltage withstanding capabilities. After evaluating both test results and production feasibility, it is recommended that Concept "C" be considered by NASA engineering. However, since no concept corrected the changes in interbridge characteristics and since the initiator is energized only on one circuit, it is also recommended that serious consideration be given to a two-pin, single bridgewire Apollo Standard Initiator.

It is to be noted that Concept "C" can be incorporated in the two-pin unit to provide an environmentally immune electrostatic insensitive initiator.

V <u>DISCUSSION OF CONCEPTS</u>

1.0 CONCEPT A

This concept was proposed as an initial feasibility study of the controlled gas encapsulation approach. However, this concept was deleted from the program and replaced by Concept H.

1.1 CONCEPT B

This concept, as proposed, was similar to Concept A with the exception that a ceramic disk hermetically sealed, by means of soldering and/or brazing was to be utilized rather than the isomica disk environmentally sealed with epoxy.

Great difficulty was encountered in obtaining a simultaneous hermetic seal around the pin header assembly, the alumina disk and the four pins. In all cases where the hermetic seal was obtained, the spark gap was found to be shorted to the pins of the header. Utilization of different temperature solders and closer mating surface central did not provide a solution.

During discussions of these problems with the cognizant NASA engineer, it was decided that fabrication of the units would be accomplished using epoxy for sealing the ceramic disk. Refer to revised concept drawing. After the unit was completely fabricated, the gas plenum around the spark gap was tested for seal integrity by placing the units in a vacuum chamber, reducing and maintaining the pressure at one inch Hq absolute (minimum) for 25 minutes minimum. The chamber was then filled and pressurized with helium to 15 psig. After a 5-minute minimum soak at 15 psig, the units were removed and checked on a Veeco Leak Detector. All units tested under vacuum conditions had a leakage rate of less than 1 x 10⁻⁶ cc He/Sec.

All units tested had been potted with SOS-100 Compound followed by removal of the connector end.

1.1.1 TEST RESULTS

Units 05, 06 and 07 were pulsed at the sea level condition. An anomaly occurred between the first and second pulsing of the above units.

On 7/27, these units were pulsed with Post pulsing electrical 25,000 volts dc. testing indicates that as before, interbridge resistance measured between Circuits A-B and C-D, readings changed from less than 1.000 to above 4.0 on the AERMI. However, the units were re-tested on 7/28 prior to the second static pulse and the interbridge readings had reverted to less than 1.00. During subsequent pulsing, these values fluctuated between above 4.0 and below 1.00. It is to be noted that these results were only obtained on the above units.

Vacuum testing of the remaining units
Serial Nos. 02, 03 and 04 produced the
following results. Unit 02 fired with the
first static pulse. A breakdown voltage of
2020 volts was indicated on the unit. The
remaining units did not fire after being subjected to five pulses at the 25,000 volt
level. However, after two pulses, no interbridge capacitance reading could be obtained
on Unit 03. After five pulses, the interbridge resistance of this unit was measured
on a Cubic Digital Ohmmeter and found to be
248.1 ohms.

1.1.2 CONCLUSIONS

This concept does provide additional protection for units being statically pulsed under vacuum conditions. However, this protection is only with respect to firing of the unit. The interbridge characteristics of the unit still change.

1.2 CONCEPT C

This concept permitted the use of standard components now being used to produce the Apollo Standard Initiator. lowing modifications were made on the header assembly prior to installation in the initiator body. An angular groove .012-.015 inches wide by .030-.032 inches deep was ground around the outside diameter of the header. This groove exposed the .020 diameter portion of the Kovar pins. Four short pieces of stainless steel wire were placed between the four pins to act as a support and provide proper discharge gap between each pin and another piece of stainless steel wire which was placed on top of the four pieces. The latter wire formed a 360° ring around the header and was sealed in place with a Du Pont conductive silver preparation No. 5504A to prevent solder from entering the discharge cap.

During the first pulsing of units, it was observed that there appeared to be an arcing between the connector and the initiator case. Testing of the ASI standard pulsing connector indicated that the connector insulation broke down between 9,000 and 10,000 volts dc. Subsequent testing of a modified Bendix connector showed that this Bendix connector would withstand 14,000-15,000 volts dc before breakdown occurred. Further investigation showed that arcing between the connector and the initiator body occurred between 1,500 and 2,000 volts dc. Based on the above results, Space Ordnance contacted

the cognizant NASA engineer and requested that we be allowed to pot the connector end of the initiator with an insulating compound and then remove the connector end just behind the hex portion of the body, thus providing in insulation barrier which would have forced the applied voltage through the spark gap. This approval was received. (Refer to Modified Concept Configuration Drawing in Appendix.)

1.2.1 TEST RESULTS

Units 01, 02 and 03 were initially pulsed at sea level condition, with 25,000 volts dc before the initiators and connectors were modified. Unit 03 fired when this pulse was applied. The remaining units did not fire; however, interbridge resistance changed to a reading above 4.0 on the AIRME for both units. Unit 02 fired during the second pulse with a breakdown voltage of 2,020 volts. Unit 01 withstood five (5) static pulses without firing. Significant changes in both interbridge resistance and capacitance Interbridge resistance changed occurred. from less than .100 to greater than 4.0 on the AIRME after the initial pulse and interbridge capacitance changed from 2.3 pf to 42.7 pf after five (5) pulses.

Units 05, 06 and 07 all fired with the first pulse of 25,000 volts. These units showed voltage breakdown levels of 2,820, 2,700 and 3,100 volts respectively.

1.2.2 CONCLUSIONS AND RECOMMENDATIONS

The initial testing of this concept produced only negative results. However, during discussions with NASA personnel, it was decided that seven additional units would be fabricated and tested. These units were manufactured in the same manner as the initial units; however, the exposed portion of each .020 diameter pin in the angular groove was formed, by staking, into a sharp point which would provide a sharp surface for the pulse to discharge through.

These additional units have been tested, and the results are as follows:

Unit Serial No. 08 withstood five (5) pulses of 25,000 volts without firing. Current leakage between shorted pins and case increased from one (1) micro amp at 500 VAC prior to pulsing to greater than 100 micro amps at 400 volts ac after pulsing. Interbridge resistance changed from an initial level of .072 to greater than 4.0 on the AIRME after the first application of voltage. Breakdown voltages ranged from 1,900 volts maximum to 650 volts minimum. The unit was pulsed while being maintained at a vacuum level of 1 x 10⁻⁶ mm/Hg.

Unit Serial Nos. 011, 012 and 014 also withstood five (5) pulses of 25,000 volts without firing. However, each unit changed interbridge resistance from less than .100 on the AIRME prior to initial pulsing to greater than 4.0 after pulsing. Interbridge capacitance and pin

to case capacitance increased with successive pulses. Breakdown voltages on these units ranged from a maximum of 2,450 volts to a minimum of 1,050 volts. These units had also been conditioned at a vacuum of 1×10^{-6} mm/Hg.

Unit Serial No. 013 was subjected to and fired during the first application of 25,000 volts.

Unit Serial No. 016 was subjected to, and passed without firing, five (5) pulses of 25,000 volts. Interbridge resistance again changed from less than .100 on the AIRME to greater than 4.0 following first static pulse. Interbridge capacitance and pin to case capacitance increased with successive pulsing. Spark gap breakdown occurred between 2,025 volts maximum and 1,700 volts minimum.

1.2.3 CONCLUSIONS

Additional testing completed on Concept C, which provided a sharp point for voltage breakdown, has shown that this concept does provide additional protection for units being statically pulsed either at sea level or vacuum conditions. However, this protection is only with respect to firing of the unit. The interbridge characteristics, such as interbridge resistance (Circuits A-B to C-D), interbridge capacitance at one (1) megacycle (Circuits A-B to C-D), and pin to case capacitance at one (1) megacycle (shorted pins to case) are still affected by pulsing at high voltage levels.

1.3 CONCEPT D

This concept utilized a cross configuration (See Concept D Revised Illustration in Appendix.). This configuration was produced by initially metallizing the ceramic slug, prior to brazing of the contact pins, over its entire outer surface. Following metallizing, a path was ground across the pin hole surfaces which provided a .010 gap between the contact pins and the metallized surface of the header assembly.

The header spark gap was environmentally sealed in the same manner as Concept B.

1.3.1 TEST RESULTS

A total of six (6) of these units have been tested.

Unit Serial Nos. 08 and 03 were subjected to five (5) successive pulses of 25,000 volts. Both units had current leakage between shorted pins and case in excess of 100 micro amps at voltage levels of 200 and 400 volts ac respectively prior to initial pulsing. Following initial pulsing of 25,000 volts, neither unit exhibited interbridge resistance characteristics in excess of 1.0 on the AIRME; however, both units exhibited a current leakage of more than 100 micro amps at 10 volts ac following initial pulsing.

Following a second pulse of 25,000 volts, both units show a shift in interbridge characteristics in excess of 1.0 on the AIRME. Interbridge and pin to case

capacitance at one (1) megacycle increased with successive pulsing on both units. Dissection of the units following testing showed that the resistance breakdown when the unit was subjected to 500 volts ac and 500 volts dc did not occur across the spark gap.

Units 02, 04, 05 and 07 were subjected to voltage pulses while being subjected to a vacuum level of 1×10^{-6} mm/Hg. None of these units fired as a result of high voltage application.

Units 02, 04 and 05 retained interbridge characteristics after being subjected to one (1) 25,000 volt pulse. Interbridge resistance on these units, although changing, did not change to the extent of previous units; that is, the change was not in excess of 1.0 on the AIRME.

After three (3) applications of 25,000 volts, Unit Serial No. 02 showed an interbridge resistance between Circuits A-B and C-D of 1.5 on the AIRME. Subsequent pulsing and testing produced interbridge resistance readings of less than 1.0; that is, .175 and .096 on the AIRME.

Unit Serial No. 04 withstood three (3) pulses of 25,000 volts before interbridge resistance changed to a level greater than 4.0 on the AIRME.

Unit Serial No. 05 withstood one (1) pulse before interbridge resistance exceeded 4.0 on the AIRME. In all cases, interbridge capacitance and pin to case

capacitance increased with successive pulses.

Breakdown voltages across the internal spark gap of the units conditioned at 1×10^{-6} mm/Hg were a maximum of 1,775 volts and the minimum of 700 volts.

1.3.2 CONCLUSIONS

As with previous concepts tested, Concept D test results indicate that additional protection, with respect to inadvertant firing caused by high voltage static pulses, has been provided. However, this protection is only with respect to firing of the unit. The interbridge characteristics of the unit still change.

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1.4 CONCEPT E

This concept was predicated on the use of General Electric Thyrite varistor material. This is a non-linear material whose electrical characteristics are such that the current flow increases as a direct power of the applied voltage. That is, the resistance of the material drops sharply as the voltage across the mass is increased.

Prior to fabrication of units per Concepts E and F, it was believed that a preliminary investigation of standard varistors was necessary. This test data is presented in Table II of the Appendix. During these tests, each of three (3) possible failure modes were isolated with the varistor installed only in the circuit in question and the static discharge applied to that circuit. The circuits isolated and tested were Pin A to case, Pins A to B, and Pins B to C. In order to isolate each mode, leads were attached to specific pins, and the connector end was potted with insulating material.

1.4.1 PRELIMINARY TEST RESULTS

Preliminary testing indicated that the varistor material in series with the initiator circuit did, in fact, improve the ability of the initiator to withstand high voltage pulses without firing.

Initial testing did show that the initiators with varistors, in series with specific tests circuits, did more reliably withstand high voltage electro-static pulses. However, it was found that the disc material would not provide the other necessary electrical characteristics; that is, insulation resistance at 500 volts dc, dielectric strength at 500 volts ac.

The test results recorded in Table I for Concept E were conducted to determine the degree of protection and the electrical characteristics that could be obtained utilizing existing varistor materials. These tests, therefore, are of an investigative nature and are presented only for evaluation of the feasibility of using varistor materials in the initiator. It is to be noted in both insulation resistance and dielectric strength testing that in most cases the 500 volt level was not obtainable due either to low resistance of the material or high rate of current leakage upon applied voltage. Therefore, the readings obtained and recorded, in most cases, do not meet the specification requirements of the Apollo Standard Initiator. It is to be noted, also, that no units fired as a result of static pulsing. All units were tested either at sea level conditions or at a 1×10^{-6} mm Hg deep space environment.

1.5 CONCEPT F

This concept was discontinued until the results of Concept E were evaluated. Following the outline tests of Concept E, This concept has been discarded.

1.6 CONCEPT G

This concept utilized the Faraday shield. No static gap was provided in this concept. Three units were pulsed with 25,000 volts dc, and all three fired on the first pulse. Therefore, this concept has been abandoned and no further testing is scheduled.

1.7 CONCEPT H

As previously stated, this concept replaced Concept A. This concept utilized the Faraday shield of Concept G in conjunction with the encapsulated spark gap of Concept B. As with Concept G, testing proved negative. Two units were pulsed at the 25,000 volt level and both fired. Pulse voltage was reduced to 9,000 volts, and an additional unit was tested. This unit also fired. Testing was stopped and no further tests will be conducted on this concept.

2.0 TESTING SEQUENCE AND PROCEDURE

Prior to and following each static pulse, the following tests were conducted. All electrical tests were conducted at the sea level condition and ambient temperatures.

2.1 <u>INSULATION RESISTANCE</u>

The resistance between the shorted initiator terminals and the body of the initiator was measured on each unit by applying 500 ±25 volts dc for 60 ±5 seconds using a megohmmeter. The test setup used was similar to the one shown in Figure I.

2.2 BRIDGEWIRE RESISTANCE

The resistance of the internal circuits of each unit was measured and recorded while installed in a test setup similar to the one shown in Figure II. The resistance values were measured with a Cubic Digital Ohmmeter (I = 0.014 amps maximum).

2.3 <u>DIELECTRIC STRENGTH</u>

Each unit was installed in a test setup similar to the one shown in Figure III and placed in a safety enclosure. They were then subjected to a 500 volt rms 60 cps test potential applied between all shorted pins to case for a period of one minute. The leakage current was measured throughout the one-minute period. The leakage of each specimen was recorded at the end of the one-minute period.

2.4 INTERBRIDGE CAPACITANCE

See Figure IV.

2.5 PIN TO CASE CAPACITANCE

See Figure V.

2.6 <u>ELECTROSTATIC SENSITIVITY TEST</u>

Each unit was placed in a protective enclosure and connected to a test circuit similar to the one shown in Figure VI. A 500 pica-farad capacitance was charged to a specified voltage and discharged between the shorted bridgewire pins and the initiator case.

2.7 VACUUM TESTING

Those units which were tested under vacuum conditions were placed in the vacuum chamber and conditioned at 1×10^{-6} mm Hg for a period of 15 minutes minimum prior to electrostatic pulsing. Following pulsing, the units were returned to sea level conditions, removed from the vacuum chamber and the characteristics re-tested, replaced in the chamber and re-tested.

3.0 GENERAL TESTING

3.1 STANDARD UNITS

Prior to testing of these concepts, seven SO1-266-3 Initiators were subjected to the outlined testing sequence and procedure.

Static pulsing of units 0006, 0211 and 0013 was conducted at sea level with an initial pulse of 9,000 volts. The voltage level was raised in 3,000 volts increments until the unit either fired or reached 30,000 volts, this level being equipment limited.

Unit Serial No. 0006 had been rejected in final lot acceptance for high bridgewire resistance on Circuit A-B. remaining characteristics were per specification. Upon pulsing at 9,000 volts, the interbridge resistance changed from .110 to 4.446 on the AERMI, interbridge capacitance changed from 3.4 pf to 6.2 pf. Pin to case capacitance changed from 11.0 pf to 11.7 pf. Breakdown voltage recorded was 620 volts. Subsequent pulsing at higher levels produced slight changes in the above characteristics. After the fourth pulse, the connector being used for insulation resistance testing was found to have a low resistance 35 to 55K megohms. A special teflon connector was fabricated which would give accurate readings. This change in connector masks changes in the insulation resistance measurements recorded on this unit.

This unit withstood pulsing to 30,000 volts. The unit was then subjected to a

vacuum level of 1 x 10⁻⁶ mm Hg and pulsed with 20,000 volts. Following pulsing, the unit was returned to sea level condition and the electrical characteristics were recorded. This unit was then pulsed at vacuum and 13,000 volts rather than 23,000 volts. The unit fired. Spark gap breakdown on this unit varied between 500 and 2,000 volts.

Unit Serial No. 0211 had been rejected for high bridgewire resistance on Circuit C-D. The remaining characteristics were per specification. This unit produced an interbridge resistance of 1.214 on the AERMI prior to electrostatic pulsing. In the past, it was felt that only units which had been pulsed produced a reading greater than 1.000 on the AERMI. Further investigation into the history of this unit has shown that this unit had not been previously pulsed. Pulsing at the 9,000 volt level changed interbridge characteristics from 1.214 to 4.414. withstood a pulse level of 30,000 volts at sea level. The unit subsequently fired when pulsed with 10,000 volts at a vacuum of 1×10^{-6} mm Hg. Spark gap breakdown varied between 1480 and 2080 volts.

Unit Serial No. 0013 had been also rejected for high bridgewire resistance (1.16 ohms) on Circuit C-D during final lot acceptance. Interbridge resistance changed from .450 to 4.444 after pulsing at 9,000 volts. This unit withstood 30,000 volts and subsequently fired when pulsed with 20,000 volts when at a vacuum of 1 x 10⁻⁶ mm Hg. Spark gap breakdown varied between 1,000 and 1,790 volts. Breakdown voltage at vacuum was 3150 volts.

Based upon data from the above units, an initial voltage level of 15,000 volts was chosen for units to be tested at vacuum, Serial Nos. 0184, 0180, 0118 and 0120, Lot No. AEK.

Unit Serial No. 0184 had been rejected as a helium leaker with an overall leak rate of 5.6×10^{-6} cc He. Bridgewire Circuit A-B had a low resistance of .923 ohms.

The unit was pulsed at 15,000 volts when at a vacuum of 1×10^{-6} mm Hg. The unit fired at this voltage level. Spark gap breakdown was 3,600 volts.

Unit Serial No. 0180 had been rejected prior to final lot acceptance as a helium leaker, subsequent testing determined that the electrical characteristics were per specification. Initial voltage level for the unit was reduced to 10,000 volts due to firing of 0184. Pulsing at 10,000 volts changed interbridge resistance reading on AERMI from .113 to 4.410. Interbridge capacitance changed from 3.0 pf to 6.8 pf, and pin to case capacitance changed from 9.8 pf to 11.0 pf. The unit was pulsed at 23,000 volts rather than 13,000 volts on the second pulse. The unit did not fire. The voltage level was reduced to 15,000 The unit fired volts and pulsing continued. when a voltage level of 21,000 volts was reached.

Unit Serial No. 0118 was rejected during final lot acceptance as a helium leaker, subsequent testing determined that the electrical characteristics were per specification. This unit was pulsed initially with 15,000 volts. The unit did not fire; however, interbridge resistance changed from .068 to 4.247, and interbridge capacitance

changed from 3.6 pf to 4.5 pf, and pin to case capacitance changed from 7.7 pf to 10.5 pf. Initial insulation resistance was 35K megohms at 500 VDC and current leakage at 500 VAC was 6.0 micro amperes. After pulsing at 15,000, 18,000 and 21,000 volts, a short was created in the Dielectric Strength Mode and insulation resistance had changed from 35K megohms to 7 megohms. Pulsing at 24,000 volts developed a short in the insulation resistance mode. pulsing to 30,000 volts did not fire the This indicated that the breakdown path was not on the charge cup side of the header.

Dissection of the unit showed that pulsing had created a path between a header pin and the initiator body. This path was along the surface of the ceramic.

Unit Serial No. 0120 was rejected during final lot acceptance for an insulation resistance of less than one (1) megohm. As would be expected, this unit did not fire during pulsing; however, even with the short between the pins and case, interbridge resistance changed from .068 to .427 when pulsed with 15,000 volts and from .427 to 4.390 when pulsed with 18,000 volts.

Dissection of the unit also showed a shorting path between the potting compound and the ceramic face.

3.2 SPARK GAP BREAKDOWN

This investigation was instigated to determine the reproducibility of breakdown voltage with a constant gap width. Two electrodes with .030 radii were rigidly positioned with a .010 air gap. This test setup was made in

the vacuum fixture so a vacuum could readily be applied without moving the setup. Three 9,000 and 25,000 volt discharges were conducted at both sea level and 1 x 10⁻⁶ mm Hg. Breakdown occurred between 3,000 and 4,500 volts at the 9,000 volt level and between 3,500 and 4,000 volts at the 25,000 volt level when at sea level.

After subjecting the test setup to a vacuum pressure of 1.1 x 10⁻⁶ mm Hg, three pulses of 9,000 volts were conducted. Of these, only one test indicated a breakdown voltage that being 6,300 compared to a previous high of 4,500 volts. Four pulses of 25,000 volts produced breakdown voltage between 11,000 and 13,200 volts.

Thus, the existing spark gap in the initiator, when subjected to a vacuum level of 1.1×10^{-6} mm Hg and a static pulse of 9,000 volts, will not reliably break down; and when breakdown does occur, it is at approximately twice the voltage observed at sea level. Breakdown voltage at a pulsing level of 25,000 volts occurs at approximately the same level as sea level conditions; however, under vacuum conditions, the breakdown levels are approximately three times as high.

3.3 INITIATION CHARGE PELLET INVESTIGATION

Testing of the units showed that changes in interbridge resistance were still prevalent. Investigations of the electrical characteristics of the initiation charge pellet have been conducted.

Initiation charge pellets were fabricated by pressing the initiation mix in standard pin headers and then cracking the ceramic charge cup and removing
the pellet. Pellets were made using
compaction pressures of 26,500 psi and
12,500. Insulating material was painted
and cured on the circumference of the
pellet in an effort to force applied
voltage through the pellet.

One pellet of each density was placed between aluminum contacts and pulsed with 500 volts dc. Resistance, across the pellet, was measured before and after each pulse with the AIRME. Capacitance of the pellet was measured at one megacycle. Attempts were made to record dielectric strength of the pellet; however, current leakage was too great at high voltage. After each pulse testing on the AIRME showed a change in resistance characteristics; however, it was found that with the application of approximately 300°F for approximately 30 seconds, the resistance across the pellet returned to less than 1.00 on the AERMI. pulsing, recording and heating cycle was repeated three times on the high density pellet and twice on the lower density pellet. In all cases resistance across the mix returned to the pre-pulse level. After three cycles of 500 volts dc, the voltage level on the dense pellet was increased in 500 volt increments until the pellet fired. This pellet fired when pulsed with 3,000 volts.

A second high density pellet was tested in the same manner except that a .005thick mylar disk was placed between one side of the pellet and the aluminum contact. This pellet was pulsed starting at 500 volts dc and subsequently withstood 3,000 volts dc without either loosing resistance characteristics or firing.

Additional testing of the pellet was conducted by placing a dense pellet between two sharp probes and applying voltage in 5 volt increments. Each voltage level was maintained for a minimum of 30 seconds. The current leakage in micro amperes was recorded at the end of this period. After reaching the 60 volt level, testing was stopped. This level was limited by the available power supply. The pellet was tested to breakdown using ac voltage. Breakdown occurred at 160 VAC.

Following breakdown at 160 VAC, the pellet was again subjected to dc voltage levels, and leakage characteristics were again recorded. Resistance characteristics as expected were greatly reduced; however, it was found that by a slight movement of the pellet, the resistance characteristics returned. This test indicates that interbridge characteristic changes are with respect to a minute portion of the initiation charge only. Refer to data sheet and voltage vs current leakage plot.

In an effort to determine possible voltage surges at the charge side of the header, leads were welded to the pin faces and attached to an oscilloscope. A direct short between the pins and the case was created on the connector end of the header assembly, the unit was pulsed, and an oscilloscope picture taken of the surge voltage on the charge side of the header. Voltage levels of 500 and 550 volts dc were recorded.

This indicates that even though pictures taken of static breakdown voltage across the spark gap show voltage levels between 1,000 and 2,000 volts, the unit may be seeing surge voltages greatly in excess of the indicated voltage.

3.4 INTERNAL PULSE PROTECTION

As a result of the possible surge voltages, methods of internally insulating the circuits in an effort to stop breakdown of the initiation charge pellet were discussed.

Two methods were tried. The first method consisted of painting the initiation charge slurry with a resistive varnish, curing and then pressing initiation charge. These units are designated as A, B, C, D and E varnish on the data sheets.

The second method consisted of inserting a mylar insulating disk over the slurry and then pressing the initiation charge in place. Units were fabricated using three thicknesses of mylar; .002 designated on the data sheets as A₁, A₂, A₃, A₄ and A₅; .003 designated on the data sheets as B₁, B₂, B₃, B₄ and B₅; and .005 designated as C₁, C₂, C₃, C₄ and C₅.

One each of the above concepts was subjected to pulses starting at 9,000 VDC and subsequently were pulsed at 25,000 VDC. Concept A which utilized insulating varnish changed interbridge characteristics in the same manner as a standard unit.

The units with mylar disks between the slurry and the initiation charge pellet all withstood 25,000 volts with no significant changes in interbridge characteristics.

Four of the units with .002 mylar were placed in initiator bodies and subjected to a one amp, no fire test. Two units did not fire after 5 minutes. One unit fired approximately 2 minutes after application of current. The fourth unit was tested at 2 amperes in error and fired immediately.

It appears that the above method of interbridge protection warrants further investigation with respect to electrical insulation materials which have better heat transferring characteristics.

VI

APPENDIX

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S/N CONCEPT	PULSE NO.	APPLIED VOLTAGE	BREAK- DOWN VOLTAGE		Bridgewire Resistance	EWI RE FANCE	DIELECTRIC STRENGTH AT 500	INTER- BRIDGE RES. CIR	INTERBRIDGE CAP. AT ONE MEGACYCLE	PIN TO CASE CAPACITANCE AT ONE MEGA-	CONDITION	COMPENTS	
				(1)	A-B	G-D	VAC MICRO AMPS	A-B to C-D	A-B to C-D	cycle			;
CONCEPT													- ·
90	-	26 000		30K	1.035	1.094	7	690.	2.7 pf	6.1 pf	,		
3	٠,	200,000		7.0K	1.030	1.088	36	.075	3.6 pf	7.5 pf	Sea Level		, (.) 1
	١ ٥	200,02	-	5.0K	1.029	1.088	98 @ 500 VAC	. 080	3.7 pf	7.6 pf	Sea Level		
		000,52		27K	1.028	1.087	09	.075	3.9 pf	7.8 pf	Sea Level		
	† u	25,000		12K	1.027	1.086	2	. 070 .	3.8 pf	7-8 pf	Sea Level		
	^	79°67		7.0K	1.027	1.087	08	.083	3.7 pf	7.9 pf	Sca Level		-
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(1) Unless otherwise noted	otherwise	noted											
													·

N-B C-D WAG MICRO AMPS NICRO AMPS	(1) A-B	RESISTANCE	STREEGTH AT 500	BRIDGE RES. CIR	CAP. AT ONE MEGACYCLE	PIN TO CASE CAPACITANCE AT ONE HEGA-	CONDITION	COMPLEMENTS
1.035 1.034 100 @ 360 VAC .070 2.9 pf 6.4 pf 1.029 1.030 100 @ 370 VAC .082 3.4 pf 7.3 pf 1.030 1.030 100 @ 370 VAC .082 3.4 pf 7.3 pf 7.4 pf 1.030 1.030 395 VAC .080 3.5 pf 7.4 pf 7.3 pf 1.028 1.030 100 @ 350 VAC 4.368 3.9 pf 7.6 pf 1.029 1.030 100 @ 320 VAC 4.368 3.9 pf 7.6 pf 1.029 1.027 1.028 100 @ 370 VAC 4.366 3.7 pf 7.7 pf 1.030 1.00 @ 370 VAC 4.366 3.7 pf 7.7 pf 1.030 1.00 @ 450 VAC .069 3.9 pf 8.0 pf 1.009 1.102 65 4.270 3.6 pf 7.7 pf 1.031 1.00 @ 450 VAC .069 3.6 pf 7.7 pf 1.079 1.044 28 .069 2.9 pf 6.4 pf 7.7 pf 1.079 1.044 28 .069 3.6 pf 7.7 pf 1.079 1.044 28 .069 2.9 pf 6.4 pf 7.7 pf 1.075 1.030 100 @ 450 VAC .360 3.9 pf 7.7 pf 1.077 1.030 100 @ 450 VAC .360 3.7 pf 7.7 pf 1.077 1.030 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.077 1.039 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.077 1.039 100 @ 450 VAC .4.369 3.9 pf 7.7 pf 1.077 1.078 1.00 @ 450 VAC .4.360 3.9 pf 7.8 pf 1.077 1.078 1.00 @ 450 VAC .4.360 3.6 pf 7.8 pf 1.077 1.078 1.079 1.00 @ 450 VAC .4.399 3.9 pf 7.8 pf 1.077 1.078 1.079 1.00 @ 450 VAC .4.399 3.9 pf 7.8 pf 1.077 1.078 1.079		- 1	VAC MICRO AMPS	A-B to C-D	A-B to C-D	CYCLA:		·
1.039 1.034 100 @ 360 VAC .070 2.9 pf 6.4 pf 1.029 1.030 100 @ 370 VAC .082 3.4 pf 7.3 pf 7.3 pf 1.030 100 @ 355 VAC .080 3.5 pf 7.4 pf 7.3 pf 1.030 100 @ 350 VAC 4.368 3.9 pf 7.4 pf 7.5 pf 1.022 1.028 100 @ 320 VAC 4.368 3.9 pf 7.6 pf 7.5 pf 1.030 1.00 @ 370 VAC 4.366 3.7 pf 7.7 pf 7.9 pf 1.030 1.00 @ 370 VAC 4.366 3.7 pf 7.7 pf 1.030 1.00 @ 450 VAC .077 3.9 pf 7.7 pf 1.030 1.00 @ 450 VAC .077 3.9 pf 8.0 pf 1.006 450 VAC .077 3.9 pf 8.0 pf 1.006 450 VAC .077 3.9 pf 8.0 pf 1.075 1.032 100 @ 450 VAC .069 3.6 pf 7.7 pf 1.075 1.032 100 @ 380 VAC .059 3.7 pf 7.7 pf 1.076 1.030 100 @ 450 VAC .059 3.7 pf 7.7 pf 1.075 1.030 100 @ 450 VAC .0430 3.7 pf 7.7 pf 1.075 1.030 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.075 1.030 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.077 1.030 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.077 1.039 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.077 1.039 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.077 1.078 1.000 4.50 VAC .4.366 4.0 pf 7.7 pf 1.077 1.078 1.078 100 @ 450 VAC .4.366 4.0 pf 7.7 pf 1.077 1.078 1.000 4.50 VAC .4.366 4.0 pf 7.7 pf 1.077 1.078 1.000 4.50 VAC .4.366 4.0 pf 7.7 pf 1.077 1.078 1.000 4.50 VAC .4.366 4.0 pf 7.7 pf 1.077 1.078 1.000 4.50 VAC .4.366 4.0 pf 7.7 pf 1.077 1.078 1.000 4.50 VAC .4.366 7.0 pf 1.077 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 1.078 pf 1.077 1.078								
1.039 1.030 100 @ 370 VAC				.070	2.9 pf	6.4 pf	Can Taye	
1.036 1.030 100@ 355 VAC	2.1K 1.029			.082	3.4 pf	7.3 pf	1	
1.022 1.030 100 @ 350 VAC 4.368 3.9 pf 7.6 pf 7.0 pf 1.028 100 @ 320 VAC 4.356 3.7 pf 7.7 pf 7.7 pf 7.9 pf	2.8K 1.030			.080	3.5 p£	7.4 pf	Sea Level	
1.027 1.028 100 @ 320 VAC 4.337 3.8 pf 7.7 pf 7.9 pf 1.029 1.027 1.00 @ 310 VAC 4.366 3.7 pf 7.9 pf	1.4K 1.029			4.368	3.9 pf	7.6 pf	Sea Level	
1.029 1.027 100 @ 370 VAC 4.366 3.7 pf 7.9 pf 7.9 pf 1.091 1.106 35 .069 2.7 pf 6.4 pf 7.7 pf 7.7 pf 7.7 pf 7.8 pf 7.7 pf 7.8 pf 7.9 pf 7.8 pf	1.2K 1.027			4.337	3.8 pf	7.7 pf	Sea Level	
1.091 1.106 95 .069 2.7 pf 6.4 pf 1.090 1.104 56 .073 3.7 pf 7.7 pf 7.7 pf 1.089 1.102 70 .080 3.9 pf 7.8 pf 7.8 pf 1.083 1.103 100 @ 450 VAC .077 3.9 pf 8.0 pf 1.075 1.102 65 4.270 3.6 pf 7.7 pf 1.075 1.032 100 @ 390 VAC .930 3.6 pf 7.7 pf 1.075 1.030 100 @ 410 VAC 1.250 3.7 pf 7.5 pf 1.075 1.030 100 @ 405 VAC 4.356 4.0 pf 7.7 pf 1.074 1.036 100 @ 450 VAC 4.356 4.0 pf 7.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC 4.356 4.0 pf 7.5 pf 1.074 1.039 100 @ 450 VAC 4.356 4.0 pf 7.8 pf 7.8 pf	.95к 1.029			4.366	3.7 pf	7.9 p£	Sea Level	
1.090 1.104 56 .073 3.7 pf 7.7 pf 1.089 1.102 70 .080 3.9 pf 7.8 pf 7.8 pf 1.103 100 @ 450 VAC .077 3.9 pf 8.0 pf 1.083 1.103 100 @ 450 VAC .069 3.8 pf 7.9 pf 1.075 1.102 65 4.270 3.6 pf 7.7 pf 1.075 1.032 100 @ 380 VAC .930 3.6 pf 7.7 pf 1.075 1.030 100 @ 380 VAC .930 3.7 pf 8.0 pf 1.075 1.030 100 @ 405 VAC 4.339 3.9 pf 7.8 pf 1.074 1.075 1.00 @ 405 VAC 4.339 3.9 pf 7.8 pf 1.077 1.078 1.00 @ 405 VAC 4.339 3.9 pf 7.8 pf 1.077 1.078 1.00 @ 450 VAC 4.339 3.6 pf 7.8 pf	 -	1.106	95	690`	2.7 pf	6.4 pt		
1.089 1.102 70 .080 3.9 pf 7.8 pf 1.083 1.103 100 @ 450 VAC .077 3.9 pf 8.0 pf 1.081 1.100 100 @ 450 VAC .069 3.8 pf 7.7 pf 1.081 1.100 100 @ 450 VAC .069 3.8 pf 7.7 pf 1.075 1.032 100 @ 380 VAC .930 3.6 pf 7.7 pf 1.075 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.075 1.028 100 @ 405 VAC 4.339 3.9 pf 7.8 pf 1.074 1.039 100 @ 450 VAC 4.339 3.9 pf 7.8 pf 1.077 1.078 100 @ 450 VAC 4.339 3.9 pf 7.8 pf	-	1.104	56	.073	3.7 pf	7.7 pf	Sea Level	
1.083 1.103 100 @ 450 VAC .077 3.9 pf 8.0 pf 1.081 1.100 100 @ 450 VAC .069 3.8 pf 7.9 pf 1.075 1.102 65 4.270 3.6 pf 7.7 pf 7.7 pf 1.079 1.044 28 0.069 2.9 pf 6.4 pf 7.7 pf 1.076 1.030 100 @ 380 VAC .930 3.6 pf 7.6 pf 1.076 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.074 1.028 100 @ 405 VAC 4.339 3.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC 4.356 4.0 pf 7.8 pf 1.077 1.078 100 @ 450 VAC 4.356 3.6 pf 7.8 pf		1.102	70	080.	3.9 p£	7.8 pf	Sea Level	
1.081 1.100 100 @ 450 VAC .069 3.8 pf 7.9 pf 1.075 1.102 65 4.270 3.6 pf 7.7 pf 7.7 pf 1.079 1.044 28 .069 2.9 pf 6.4 pf 1.075 1.030 100 @ 380 VAC .930 3.7 pf 7.7 pf 1.075 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.072 1.028 100 @ 405 VAC 4.339 3.9 pf 7.8 pf 1.074 1.039 100 @ 450 VAC 4.350 3.6 pf 7.8 pf			100 @ 450 VAC	.077	3.9 pf	8.0 pf	Sea Level	
1.075 1.102 65 4.270 3.6 pf 7.7 pf 1.079 1.044 28 .069 2.9 pf 6.4 pf 1.076 1.032 100 @ 380 VAC .930 3.7 pf 7.7 pf 1.075 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.072 1.028 100 @ 405 VAC 4.339 3.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC .450 3.6 pf 7.8 pf				690.	3.8 p£	jd 6*2 .	Sea Level	
1.076 1.044 28 .069 2.9 pf 6.4 pf 1.076 1.032 100 @ 390 VAC .930 3.6 pf 7.6 pf 1.075 1.030 100 @ 380 VAC 1.250 3.7 pf 7.7 pf 1.076 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.072 1.028 100 @ 405 VAC 4.339 3.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC .450 3.6 pf 7.8 pf		1.102	65	4.270	3.6 pf	7.7 p£	Sea Level	
1.076 1.032 100 @ 390 VAC930 3.6 pf 7.6 pf 1.075 1.030 100 @ 380 VAC 1.250 3.7 pf 7.7 pf 1.076 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.072 1.028 100 @ 405 VAC 4.339 3.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC .450 3.6 pf 7.8 pf	2.1K 1.079	1.044	28	690.	2.9 pf	6.4 pf	,	
1.075 1.030 100 @ 380 VAC 1.250 3.7 pf 7.7 pf 1.076 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.072 1.028 100 @ 405 VAC 4.339 3.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC .450 3.6 pf 7.8 pf				.930	3.6 p£	7.6 pf	Sea Level	
1.076 1.030 100 @ 410 VAC 4.366 4.0 pf 8.0 pf 1.072 1.028 100 @ 405 VAC 4.339 3.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC .450 3.6 pf 7.8 pf	2.6K 1.075			1.250	3.7 pf	7.7 pf	Sea Level	
1.072 1.028 100 @ 405 VAC 4.339 3.9 pf 7.9 pf 1.074 1.039 100 @ 450 VAC .450 3.6 pf 7.8 pf	2.8K 1.076			4.366	4.0 pf	8.0 pf	Sed Level	
1.074 1.039 100 @ 450 VAC .450 3.6 pf 7.8 pf	550K 1.072			4.339	3.9 pf	7.9 pf	Sea Level	
	5.0K 1.074			.450	3.6 pf	7.8 pf	Sea Level	

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	COMPLEXATS	
and the second s	CONDITION	1x10-6mm Hg
	PIN TO CASE CAPACITANCE AT ONE MEGA- CTCLE	6.3 pf 7.9 pf 8.4 pf 8.5 pf 8.7 pf 7.3 pf 8.2 pf 8.2 pf 8.2 pf 8.2 pf 8.1 pf 8.1 pf
	INTERBRIDGE CAP. AT ORE MEGACYCLE A-B to C-D	2.5 pf 4.6 pf 5.5 pf 6.0 pf 6.3 pf 6.3 pf 7.6 pf 8.0 pf 8.8 pf
	INTER- BRIDGE RES. CIR A-B ta C-D	4.343 4.343 4.343 4.343 4.360 4.345 4.345 4.346 4.346 4.346 4.346 4.346 4.346 4.359 4.351
	DIELECTRIC STREEGTH AT 500 VAC MICRO AMPS	100 @ 210 VAC 50 @ 150 VAC 100 @ 185 VAC 100 @ 170 VAC 100 @ 170 VAC 100 @ 315 VAC 100 @ 315 VAC 100 @ 250 VAC 100 @ 250 VAC 100 @ 475 VAC 88 @ 400 VAC 96 100 @ 425 VAC
	SWI RE FANCE C-D	1.114 1.114 1.1109 1.1109 1.1119 1.050 1.048 1.050 1.048 1.050 1.048 1.040 1.040 1.040 1.040
	BRIDGEWIRE RESISTANCE A-B C-D	1.103 1.103 1.098 1.100 1.100 1.105 1.987 1.987 1.987 1.987 1.006 1.006 1.006 1.006
	INSUL. RES. AT 500 VDC (1)	.8 @ 250 .65 @ 250 .60 @ 250 .45 @ 250 .45 @ 250 .50 @ 250 .50 @ 200 .90 @ 450 .90 @ 450
	BRRAK- DOWN VOLTAGE VDC	
	APPLIED VOLTAGE	25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000
	PULSE NO.	2 4 3 5 1 2 4 3 5 1
	S/N CONCEPT	CONCEPT "E" 01

8/8	POLSE	WPLIED	BREAK- DOWN	INSUL. RES.	Bridg eni re Resi stance	WI RE ANCE	DIELECTRIC STRENGTH AT 500	INTER- BRIDGE RES. CIR	INTERBRIDGE CAP. AT ONE MEGACYCLE	PIN TO CASE CAPACITANCE AT ONE MEGA-	CONDITION	COMPLEMITS	
CONCERT	.	VOLTENSE	ADC	ADC.	A-B	C-D	VAC MICRO AMPS	A-B to C-D	A-B to C-D	Creirs			
CONCEPT													
(contimed)				2. JK	1.129	1.081	1.0	.091	2.5 pf	6.6 pf	1×10 ⁻⁶ mm Hg		
20	н	25,000	1700	290K	1.120	1.073	1.0	4.320	3.6 pf	8.7 pf	1×10 ⁻⁶ mm Hg		
	N	25,000	1600	27K	1.121	1.071	2.0	4.333	3.9 pf	8.8 pf	1×10 ⁻⁶ mm Hg		
	۴	25,000	1750	X8+7	1.121	1.072	2.0	4, 333	3.9 pf	8.9 pf	1x10 ⁻⁶ mm Hg		
	4	25,000	1100	90K	1.123	1.072	2.0	4.157	3.6 pf	7.5 pf	1×10 ⁻⁶ mm Hg		
	5	25,000	1325	450K	1.131	1.078	1,0	087	3.9 pf	8.6 pf			
				2K	1.078	1.033	>100 at	560"	2.9 pf	7.7 pf	Con Level		
80	_	25,000	800	Short	1.064	1.021	200 VAC >> 100 at 10 VAC	.067	3.2 pf	8.7 pf			
	2	25,000	525	15K	1.064	1.022	10.0	3.800	3.7 pf	9.0 p£	Sea Level		
	en .	25,000	1100	19K	1:062	1.021	>100 at	4.339	3.4 pf	8.9 pf	Sea Level		
	4	25,000	,	Short	1.086	1.020	30 VAC 7 100 at	.200	6.0 pf		Sea Level		7
	"	25,000		25K	1.068	1.022	10 VAC >> 100 at 250 VAC	1.100	3.6 pf	9.2 pf			
				6 0%	1.061	1.050	√100 at	660*	3.6 pf	8.4 pf			
03	–	25,000	800	100K	1.051	1.042	400 VAC Short	.078	4.0 pf	9.2 pf	Ces Level	> 100 Micro Amps at 10 VAC	
	2	25,000	200	Short	870.1	1.042	Short	4.314	4.3 pf	9.1 pf	Sea Level		
	6	25,000	200	Short	1.048	1.042	Short	4.293	6.6 pf		Sea Leve		
	4	25,000		Short	1.047	1,041	Short	.800	6.4 pf		Sea Level		
	5	25,000		Short	1.048	1.042	Shart	. 720	6.3 pf				
molardinis								-					
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COMMENTS																							
CONDITION			9,000	SH III OTXI	1x10 mm Hg	1x10 mm Hg	1×10 ⁻⁰ mm Hg	lx10 om Hg		l×10 ⁻⁰ mm Hg	1x10 ⁻⁰ mm lig	1×10 ⁻⁰ mm Hg	lx10 mm Hg	lx10 men Hg	٧	lx10 um Hg	1x10 cm Hg	1×10 cram Hg	lx10 oran Hg	lx10 orum Hg			
PIN TO CASE CAPACITANCE AT ONE MEGA-	CYCLAS		5.4 pf	6.2 pf	5.8 pf	6.1 p£	5.9 pf	5.9 pf	6.0 pf	7-4 pf	7.4 p£	7.5 p£	7.8 p£	7.8 pf	6.6 pf	8.8 pf	8.7 pf	8.8 pf	7.5 pf	8.8 pf			
INTERBRIDGE CAP. AT ONE MEGACYCLE	A-B to C-D		2.2 pf	2.5 pf	2.6 pf	2.6 pf	2.6 pf	2.7 pf	2.7 pf	3.4 pf	3.5 pf	3.5 pf	5.7 pf	5.7 pf	2.7 pt	3.9 pf	4.0 pf	4.0 pf	3.6 pf	3.8 pf	_		
INTER- BRIDGE RES. CIR	A-B td C-B		.095	300	.750	1.500	.175	960.	.092	.077	.150	007	4.157	4.163	060'	.335	4.335	4.333	2.100	4.157			
DIELECTRIC STRENGTH AT 500	MICRO AMPS		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.0	2.0	2.0	2.0	2.0	3.0			
MIRE	α - υ		1.141	1.127	1.123	1.123	1.122	1.129	1.073	1.067	1.064	1.065	1.066	1.073	1.058	1.052	1.049	1.051	1.052	1.058			 A
BRIDGENT RE RESISTANCE	A-B		1.089	1.079	1,061	1.032	1.032	1.039	1.092	1.085	1.083,	1.085	1.086	1.092	1.023	1.018	1.015	1.017	1.016	1.023		-	
INSUL. RES. AT 500) (4)		130K	19K	22K	2K	7.5K	500K	350K	65K	140K	37K	¥09	9K	1.2K	8	¥9	3.8K	11K	800K			
BREAK- DOWN VOLTAGE	ADC.		1525	1,650	0091	200	. 0071	000		0557	5//1	(747)	Ş	3	2	8/1	0001	3 9	200	acor			
APPLIED VOLFAGE			25.000	25		25,000	000,62	900,52		25,000	25,000	25,000	000 477	200,62		25,000	25,000	200,12	000,00	000°C7	,, -		
PULBS NO.	•		-			· ·	7 u	n			7 (า จ	f v	n .		- ·	۷ ،	n ×	.	^			 1
S/N CONCEPT		CONCEPT	 6. 20						ò	₹						S .	-						

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COMPERTS	Unit Fired
CONDITION	1x10 ⁻⁶ mm 1tg 1x10 ⁻
PIN TO CASE CAPACITANCE AT ONE MEGA- CYCLE	7.9 pf 9.8 pf 10.0 pf 9.8 pf 10.1 pf 10.1 pf 10.5 pf 10.5 pf 10.4 pf 10.1 pf 10.1 pf 10.1 pf 10.4 pf 10.1 pf 10.8 pf 10.8 pf
INTERBRIDGE CAP. AT ONE MEGACYCLE A-B to C-D	2.6 pf No Reading 4.4 pf 4.4 pf 4.4 pf 4.7 pf 4.7 pf 4.7 pf 5.5 pf 5.1 pf 6.7 pf 4.7 pf 4.7 pf 7.9 pf 7.9 pf 7.9 pf 8.1 pf 5.2 pf 8.2 pf 8.2 pf
INTER- BRIDGE RES. CIR A-B to C-D	.080 4.156 3.966 .082 .080 4.156 4.156 4.242 4.306 4.306 4.169 4.165 4.165 4.165 4.165 4.165 4.165
DIELECTRIC STRENGTH AT 500 VAC MICRO AMPS	1.0 1.0 4.0 12.0 3.0 25.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2
MIRE ANCE C-D	1.158 1.154 1.155 1.155 1.151 1.155 1.155 1.150 1.120 1.120 1.120 1.149 1.149 1.149
BRIDGEWIRE RESISTANCE A-B C-D	1.089 1.066 1.066 1.066 1.059 1.106 1.109 1.109 1.109 1.103 1.096 1.096 1.096 1.085
INSUL. RES. AT 500 VDC	120K 30K 130K 130K 400K 1.7K 2.3K 2.00K 1.7K 2.6K 2.6K 2.6K 2.6K 2.6K 2.6K 2.6K 2.6
BREAK- DOWN VOLTAGE VDC	1300 1050 1250 1050 1050 1125 1200 1250 1700 1725 1850
APPLIED VOLTAGE	25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000 25,000
PULSE NO.	
S/H CONCEPT.	013 013 014 016

tinued)	COMMETS	•					•										-			
TABLE I (continued)	8		Unit Fired	Unit Fired	Unit Fired															
	CONDITION		1×10 ⁻⁶ mm Hg	1x10 ⁻⁶ mm Hg	1×10 ⁻⁶ mm Hg	1.10-6-01.1	9-01-1	21 mm 01x1	Shr man Olxi	lx10 mm Hg	Lx10 mm Hg	7	1×10 7- 14g	1×10 *** Hg	1x10 rmm Hg	1×10 mm Hg	IXIO ram Hg			1
	PIN TO CASE CAPACITANCE AT ONE MEGA-		6.2 pf	6.2 pf	6.1 pf	7.7 pf	9-9 pf	10.0 pf	10.0 pf	10.1 pf	10.0 pf	8.2 pf	10.1 pf	10.4 pf	10.3 p£	10.3 pf	9.7 p£			
	INTERBRIDGE CAP. AT ONE MEGACYCLE A-B to C-D		2.4 p£	2.3 pf	2.4 pf	1 2.3 pf	5.1 pf	jd 6.4	4.5 pf	3q 6.4	4.5 pf	2.4 pf	4.6 pf	5.1 pf	4.7 pf	5.1 pf	5.4 pf			
-	INTER- BRIDGS RES. CIR		.058	.058	090.	.072	47174	3.926	4.290	4.181	4.152	.072	4.159	3.977	767.7	4.172	4.152			¥
	DIELECTRIC STRESOTE AT 500	MICRO AMPS	7.0	0.4	0.4	1.0	70.0	>100 at	7 100 at	V100 at	400 VAC > 100 at 400 VAC	1.0	2.0	2.0	2.0	2.0	2.0			
	Bridgemire Resistance	G-D	1.085	1.096	1,155	1.170	1.164	1.158	1.158	1.159	1.163	1.114	1.114	1.109	1.110	1.107	1.111			
	BRIDGENIRE RESISTANCE	A-B	1.058	1,060	1,228	1.073	1.070	1.067	1.069	1.065	1.072	1,151	1.152	1.142	1.144	1.138	1.147			
	IRSUL. RRS. AT 500 VDC		X7	500K	1000K	4K	60K	15K	×	9	X*7	28K	2 00K	80K	¥	4.8K	25K			
	BREAK- DOWN VOLTAGE VDC		2820	2700	3100	1900	200	3 5	3 5	040	8		1350	No Photo	577	0621	G#1			
	APPLIED VOLTAGE	-	25,000	25,000	. 25,000	25 000	95 000	25,000		25,000	990,62		25,000	25,000	2000,62	000,62	23,000			
	PULSE NO.		-	H	,ed		' '	, ,	, ,		^ ·		- (7 6	n .	,	n			
	S/N CONCEPT		CONCEPT 'C'' 05	8		80%	3						011			-			-	

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** Remaining units of Concept "C" had spark point on contact pins. See Concept "C" illustration in Appendix.

IABLE I (continued)	COMMENSES	Case cut away		*Poor Null			connector end cot away unit fired Connector end not cut away unit fired			Re-adjusted AERMI			
	CORLEGE	Sea Level	and the state of t		Sea tovel	[000] 100	Sea Level	Sea Level	Sea Level			Sea Level	
	CAPACITANCE (T ONE MEGA- CYCLE	6.3 pf	8.6 pf 10.1 pf	10 3 pf 10.3 pf	10.4 pf	6.0 pf	8.8 pf	6.1 pf	6.3 pf	7.4 pf 7.6 pf	7.7 pf	7.6 pf	7.8 pf
	INTE CO: MEGA A-B		4.7 pf 6.2 pf	7 8 pt	42.7 pf	2.3 pf	4 5 pf	2.3 pf	2.5 pf	2 8 pf 2.8 pf	2.9 pf	3 0 pf	3 0 pf
	INTER- SRIDGE PES. CIR A-B to C-D	090	4.510	4.519	4.524	650.	967.7	. 057	061	052	0	0	0
	STREADTH STREADTH TO SON VANC MICRO AMPS	4.0	5.0	2.5	0.9	4.0	5.0	3.5	4.0	2.0	2.0	1.8	2.1
	201132 201133 1113	1.105	1.113	1.106	1.100	1.047	1.050	.991	1.086	1.090	1.086	1.095	1.086
:	28104 S-7	1.096	1.102	1.092	1.090	1.071	1.077	1.024	1.064	1.073	1.066	1.076	1.071
	E83.	500K	50K 1000K	900K	500K	30K	7K	7 7	300K	350K 2000K	500K	X007	1000K
	sarem- doin voltage		1300	1220	1340		2020	;	}	}	1	!	;
	2011120 201113 <u>5</u>	25.000	25,000	25,000	25,000	;	25,000	25,000		1	;) ; ;	:	
, .	38750		. 2	r 4	'n		7	1		. 4	en .	4	٠ د
	S/S 705527	CONCEPT "C"	;				0.02	£0	Control Sample	3			

TASLE I (continued)	(9) 1. 2. 3. 4. 4. 4.				Interbridge resistance 248.1 oins measured With a cubic digital oinmeter.				
		1 × 10 ⁻⁶ تسا الع	1 × 10 ⁻⁶ .m H ₅		1 × 10 ⁻⁶ rm sig	1 × 10 ⁻⁶ = 1:8	1 × 10-6 mm 11g	Sea Level	Sea Level
	11. 12. 0.38 12. 0.21 (0.38) 12. 0.21 (0.38) 13. 0.21 (0.38)	6.2 pf	6.5 pf 9.7 pf	9.7 pf	10.2 pf	6.9 pf 8.9 pf	9.1 pf 10.7 pf 9.1 pf	9.0 pf 5.3 pf 5.3 pf	5.4 pf
	7 (7899-) 000 689. 7 (80) M5 (80-00) 8-3 to 0-0	4°.0 p.	4.0 pf 4.6 pf			4.3 pf 4.3 pf	4.7 pf 4.4 pf 4.4 pf	4.3 pf 2.1 pf 2.6 pf 3.5 pf	3.3 pt. 2.3 pt. 2.0 pf
	1000 00 000 000 000 000 000 000 000 000	990	.065	4.471	4.423	.064	4,466	.057	.076 .102 .129 .094
		3.0	3.0	5.0 4.5	5.0	3.0	6.4	Short Short Short	Short Short Short Short
	TELEVISION AND THE TELEVISION AN	1.050	1.121	1.081	1.081	1.125	1.114	1.102	1.130 1.123 1.122 1.123
	:	1.085	1.056	1.051	1.048	1.085	1.091	1.117 1.116 1.116 1.121	1.126 1.114 1.128 1.127 1.122
٠	검색관심	. 200K	1000%	25% 500%		300% 700%	30K 60K 1000K	Short Short Short	Short Short Short Short
	#339	2020	2000	800	0077	1100	1200	ន ន ន	8 2 3 3
- -	apypron cryp s ry	25,000	25,000	25,000	25,000	25,000	25,000 25,000 25,000	5 5 5	
,	Furst No.	-	- 2	e 4	۲n	1 2	⊌ 4 v	. t 2 w	, , ,
	10 30 870		03					01	

Service Control of the Control of th

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	Interbridge capacitance reading in error.							in erroriuge capacitatice teauting					\$100 mm and a second a second and a second a	in error.				
	Sea Level					Sea Tevel	•	Sea Sevel			r _i	מבא יינה אפר		Sea Level				sea cevel
1.4 p£) L	7.3 pt	7.5 pf	7.8 pf	7.9 p£	7.8 pf	1.4 pf	8.1 pf	7.5 pf	8.0 pf	8.3 pf	8.2 pf	1.1 pf	8.7 p£	8.5 pf	8.6 pf	8.8 pf	8.6 pf
2.6 of		4.1 pt (7-20)	5.5 pf	3.6 pf	;	3.3 pf	2.5 pf	4.1 pf (7-28)	5.0 pf	3.7 pf	3.4 pf	3.2 p£	2.8 p£	5.1 pf (7-28)	5.5 p£	4.1 p£	4.4 pf	4.1 pf
. 072	.062 (7-28)	(/Z-/) R01·5	. 630	. 320	060	671.	890	.890 (7-27)	. 180	4.406	790	090.	.062	. 150 (7-23) 4.233 (7-27)	4.391	4. 401	نة٥.	470
2.5	· ·	b.4	4.0	0.4	0.4	0.4	3.0	3.5	0.4	0.4	0.4	6.0	3.0	3.5	4.0	4.5	6.0	4.5
876	}	666	.992	166'	766	066	1.060	1.066	1.068	1.071	1.086	1.080	1.006	1.062	1.052	1.071	1.060	1.062
1.103		1.108	1.110	1.115	1.106	1.104	1.089	1.147	1.117	1.120	1.118	1.119	1.174	1.298	1.136	1,139	1.137	1.137
1000%		80K		દ	8	400K	700K	150%	1,50%	70K	20K	12K	800%	8	700 0 K	10000K	10000X	5000K
	1430	:	0011	0/01	1	1160	; ; ;	1090	1170	1150	0151	11/0		1900	1340	1500	2030	2070
	25,000	000	000,62	25,000	25,000	25,000	;	25,000	25,000	25,000	25,000	25,000	,	25,000	25,000	25,000	25,000	25,000
	1	ć	۷ .	m	4	'n		-	62	m	4	5		-	7	ო .	4	5
CONCEPT	05							9 0.						03				

	33	9 m 9 m 9 m	Established States		11 14 14 14 14 14 15 16 17 17 17 18 18 18 18 18 18 18 18 18 18 18 18 18	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CENTRAL CONTROL OF THE CONTROL OF TH	2.000 2.000 2.000 2.000 3.000	CONTRACTOR			
0118 Loe Aen	E 2 E	15,000 18,000 21,000	3000 1600 1450	35K 50 55	1.078	1.052	6.0 6.0 9.0	4.247	3.6 pf 4.5 pf 4.8 pf	7.7 pf 10.5 pf 10.9 pf	1 × 10 rm Hg	
	4 10 10	24,000	200 300 270	7.0 Short Short	1.062 1.031 1.034 1.029	1.057 1.044 1.056 1.054	Short Short Short	4.379 4.379 4.362 4.371	4.5 pf 4.7 pf 5.0 pf 5.2 pf	10.8 pf 10.6 pf 10.6 pf 10.9 pf	1 × 10 -6 m 18.	Interbridge resistance 103.9K Gins. shorted pins to case re- sistance 76.9K onns measured
0120 Lot AEK	- 2 E 4	15,000 18,000 21,000	700	Short Short Short Short	1.020 1.020 1.023	. 931 . 935 . 936	Short Short Short Short	. 427 4.390 4.394	7.4 pf 4.4 pf 6.8 pf 4.1 pf	9.1 pf 10.7 pf 11.4 pf 11.6 pf	1 x 10 mm Hg	with a cubic digital ohmmeter.
-	* v v	27,000	\$0	Short Short Short	1.022	. 935 934 923	Short Short Short	4.385	8.7 pf 7.7 pf 6.1 pf	12.1 pf 11.7 pf 11.6 pf] × 10 ⁻⁶ rm ¹¹ 5	Interbridge resistance 153.9K oims: shorted pins to case 3.979 regolms measured wit: a cubic

TABLE I (continued)

TABLE I (continued)

Unit fire

E

1 × 10°5

11 0 pf

8.2 pf

4.392

7.5

1.094

1.025

2000K

370

21,000

Si .						Pulsed at 13,000 valts by mistaka - should have been 23,000 unit fired.	Unit had not previously been	pulsed					OPTION TO THE PROPERTY OF THE		
	Sea Level		•		Sea Level	1 x 10 -6 mm Hg	Sea Level							Sea Level	Sea Level 1 x 10-6 mm Hg
200 028 200 201 80 200 201 80 200	11.0 pf	11.7 pf . 11.8 pf	11.8 pf 11.9 pf	11.9 pf	12.0 pf	10.2 рf	10.5 pf	10.6 pf	10.7 pf	10.9 pf	10.9 pf	10.9 pf	10.8 pf	10.9 pf	10.9 pf
# 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	3.4 pf 6.2 p£	6.6 pf 6.0 pf	6.3 p£ 6.8 p£	6.6 pf 6.4 pf	6.3 pf	6.0 pf	3.1 pf	4.1 pf	4.3 pf	4.5 pf	4-6 pf	5.5 pf	4.9 pf	4.7 pf	4.6 P£
23.224 03.1008 833.018 8-53.018	.110	4.440	4.254	4.410	707 7	4.414	1.214	4.414	4.428	4.238	4.238	4.212	4.363	4.387	4.403
DIFLECTRIC STRENGH AT FOO UNC HICRO AMPS	3.0	6.0	6.0 7.0	6.0	0.9		3.0	3.0	2.4	5.0	0.9	7.0	5.5	5.0	5.5
SOUTH	1.11	1.107	1.103	1.100	1.101	1.104	1.200	1.183	191.1	1.153	1.155	1.153	1.140	. 1.143	1.141
2	1.16	1.158	1.154	1.148	1.149	1.154	1.080	1.074	1.073	1.067	1.070	1.068	1.070	1.071	1.070
1835h. Res. 377-362	35K 35K	. 26K 55K	\$\$ \$\$	75x	80K	X	35K	38K	25K	58K	40K	8	14K	28K	388
18 17 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	620	1430	1270	2000	1950	099		061	0007	0607	1970	1980	0761	2677	1480
A pursu voutass	9,000	15,000	21,000	24,000	30,000			000.4	7, 400	000,53	18,000	21,000	000,42	000*17	30,000
71. 20.		ı m ¬	4 12	9 /	80 0) 01	•	e	7 (n .	dr 1	م ،	۱ ۵		60 0
8	; ¥	Unit	. ,					USII Lot AEK			اوي د د		···	· ja	• • • •

TABLE I

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#Following this Test an improved shorting connector having higher insulation resistance and dielectric strength properties will be used.

0000000	Unit fired	Unit fired	Unit fired	Cance 1.12 obms. Unit fixed circuit B-C Resistance 1.13 obms. Unit fixed circuit B-C Resistance 1.20 obms.
	1×10 ⁻⁵ vm Hg	1×10 -6 mm Hg	1×10"6 nm Hg	Sea Level Sea Level Sea Level
NE TO CASE CAPACITYNCE ST ONE NEGA- CYCLE	17.4 pf 9.7 pf	16.6 pf	17.2 pf	11.7 pf 11.6 pf 11.8 pf
CAP CAP WEGAD A-B	AN AN	NA N	NA NA	₹ ₹ ٪
TWTER- BRIDGE FES CIR	NA NA	≸	Ą.	\$ \$ \$
DIFLECTRIC STAZNOTH NT SCO VIC MICRO AMPS				5. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8. 8.
DRIDODNIRG RESIGNACE	1.08	1.08	1.07	1.041
ERICO RESIES	1.10	1.13	1.10	1.092
INSUL. RES. AT 30 VDC	100X	, 700K	700K	1500K 3000K 1000K
BPEDM- DOWN WOLTAGE VDC	3100	1400	1800	1950 1950 1500
APPLITED VCLINGE	25,000	25,000	25,000	25,000
35772		_{pre} t		
50 Si	CONCEPT "G"	0.00	£0	CONCEPT "H" 02 03 03 04

TABLE II

						•	,	-							٠,	
	REMARKS	UNIT FIRED	UNIT FIRED					•					NO FIRE TEST			
	POST PULSE POST-PULSE CAPACIMYE AIRME IN PULSE IN PULSE MODE	1	ı	.057	950.	0.0	110	890.	890	690.	068	190		190	010	89.0
			,	15.2件	15.4 PF	14.3.PF	15.0 PF	16.1 PF	16,2PF.	16,0PF	16191	16.101	1	16.5PF	16.4PF	16.0 PR
	VARISTOR	0 7	0 7	YES			•								•	- 人 こ こ こ
,	PULSE	740-	10 K	12 K	14 KV	16 KV	1.8 K.	20 KV	22 KV	24 KV	SOKY	28K2	30 K	12 KV	14 K	> V V
,	PRE-PULSE AIRME IN PILSE MOÜE	990.	210	اله.	150.	050.	890	10.	0 0	890,	690.	.068	190.	, & LO	<u> </u>	010.
,	PRE-PULSE CAPACITAIKE IN PULSÉ MODE	8.2 PF	8.3PF	8 2 DE	15.20 F	15.4PF	14.3PF	15,000	16.19E	16.2PF	16.0PF	16.175	16191	18.40日	16 ESPE	16.4 DF
	PULSE	PN B10 CASE	•. •.												•	PIN BTO CASE
	7	1200G	12005	12036			·					•		12044		

TABLE II

PINED ロアコアになっ DIN PIRED REMARKS とココ POST PULSE POSTIPULSE 35700 71 MODE ARME 4.600 4.388 4.389 890 4.931 0 CAPACITAXE AST TO N 42652 16.0 PF U.O. 136.4 10000 July 10000 CUBIC MODE 41.93 D SHORT 42,11.24 CUBIC CUBIC VARIANCE YES. が世と (FI) /信务 SES VES 人面と 07 07 XES/ VEIN FIN グダイ 02 VOLTON F 19 KN 16 KZ 10 KV 18 KL 18 KV 19 KV 14 KV 16 KV 20 KV いろおく 7 Y 01 , iod IN PULSE PRE-PULSE MODE 010 000 4.389 4.388 AIRME 0.00 990 000. 4.413 000 4.931 4.611 990, PRE-PUCE IN PULSE CAPACITAIKE CU31C 136.Ar 8.4 PF 6081C 13.02 7.87F W 144R1STOR 16.00月 90000 2000 41.930 42.65A CUS1C 147,2 A 1d19 6.1 DF 16.00PH 16.10F SHOPT CUBIC MODE 79 L'2 CVBVC DIN BTO 014710 PINATO PIN C DIN BATO DI B 70 PULSE CASE MODE CASE/ 12041 44021 12027 12018 Z

Page 2 of

TABLE II

	,											
	REMARKS			UNIT FIRED				•				
	POST-PULSE AIRME IN PULSE MACUSE	4.445	4.415	1			 					
	POST PULSE POST-PULSE VENCHAXE AIRME VENCHASE VENCHASE VENCHASE VENCHASE VENCHASE VENCHASE VENCHASE VENCHASE VENCHASE VENCHASE	0.18.00 43,45.0	CUP31C 56.05.2	ļ								
;		(j. k (k	YES	YES		,						,
		12 13.16V	22 KV	24 KV		·						
	PRE-PUIST AIRN IN FOU MADEUE	4.600	4,445	4.415		•	,					-
	PRE-PULSE CAPACTANCE IN YOUSE MOUSE	CUBIC 41, 11-2	CUBIC 43.45r	CUBIC 56.052					: .			
	FUSE	PIN A TO CASE	PIN ATO CASE	PIN ATO	۷.	,		,				
	Z/S	12041			Ç						-	

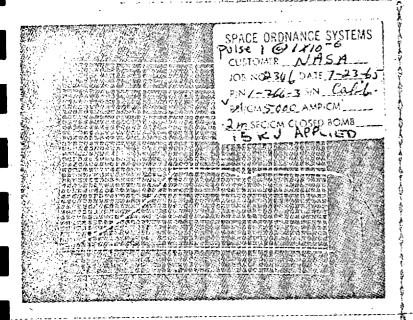
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ACE ORDNANCE SYSTEMS, INC.		
ACE ORDINATOR STOTEMS, INC.		
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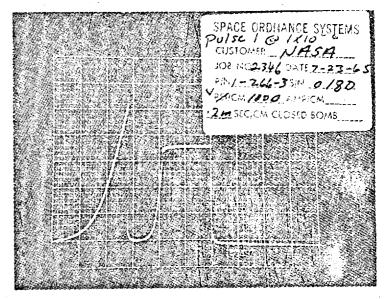
18

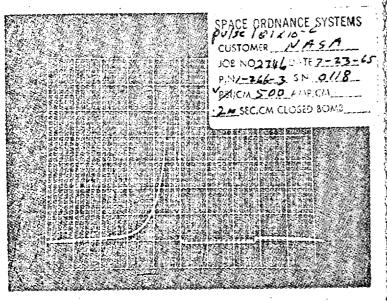
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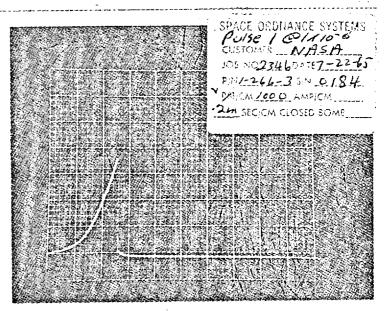
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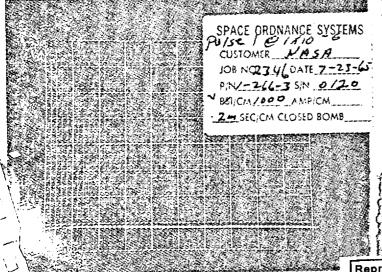
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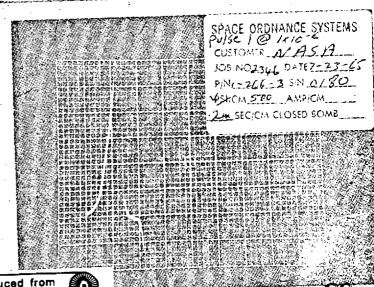




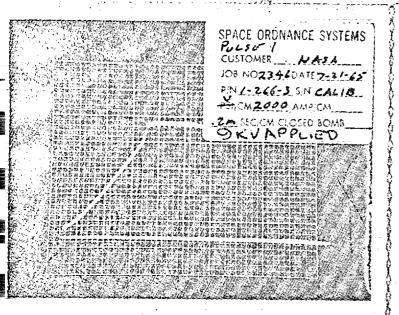


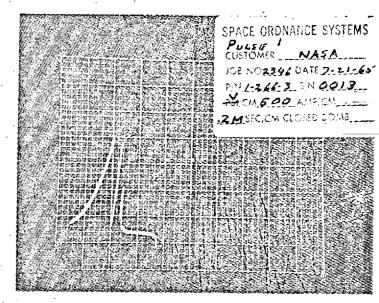


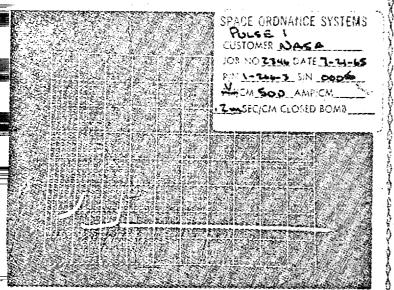


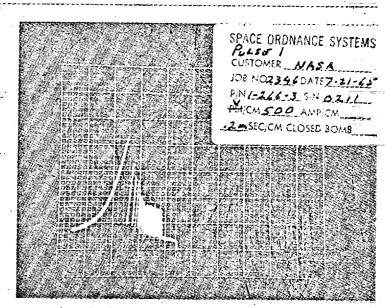


2346 AEK

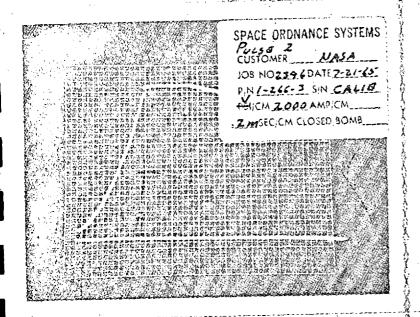


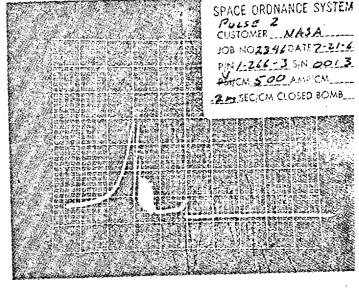


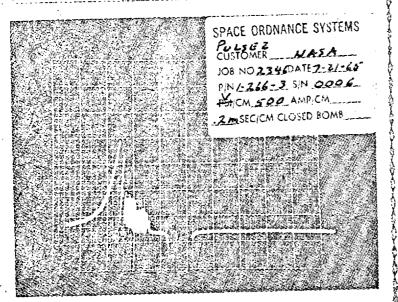


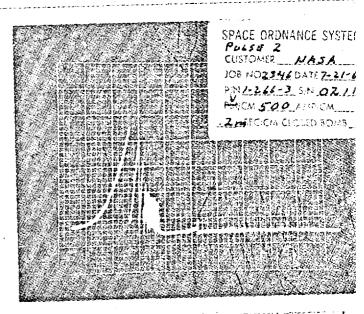


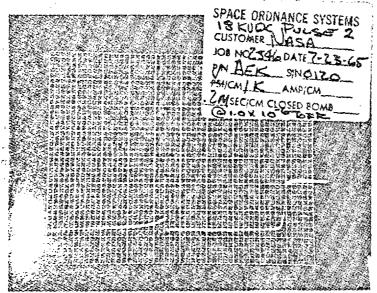
AEK__

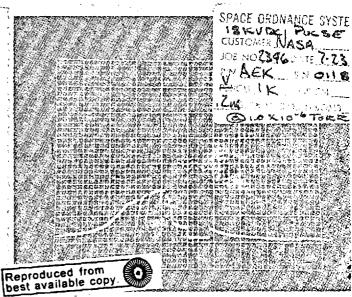


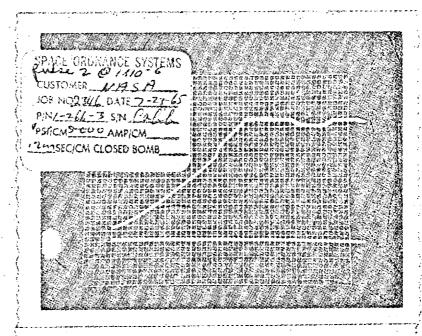


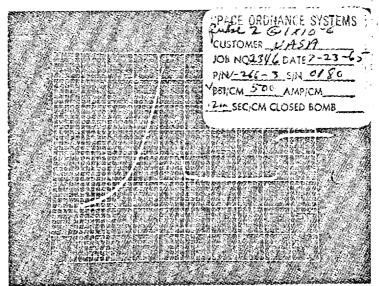


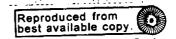




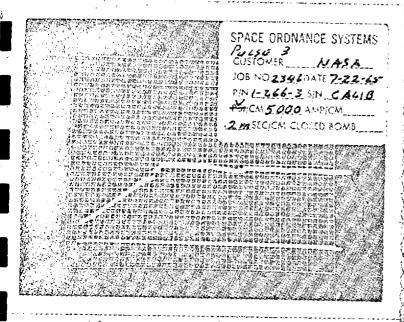


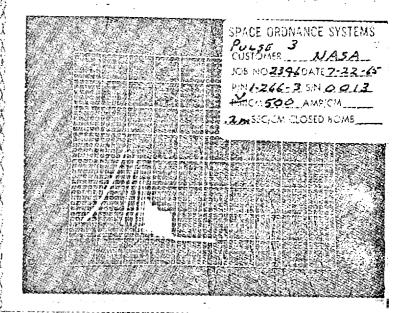


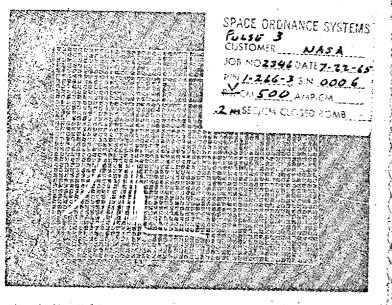


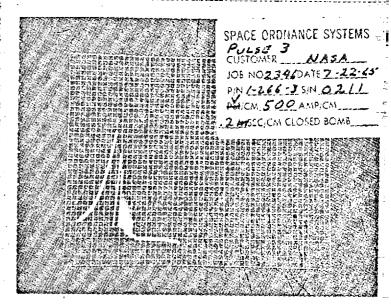


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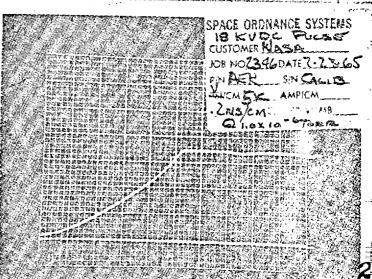


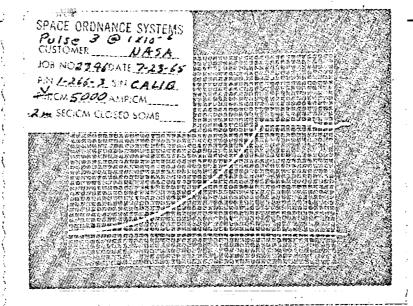


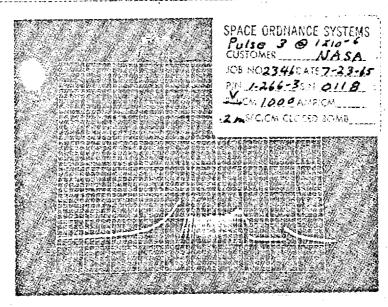


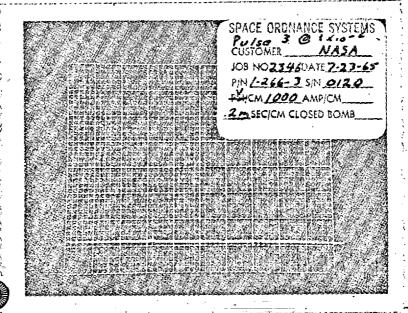




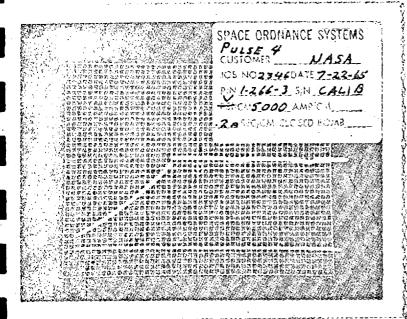


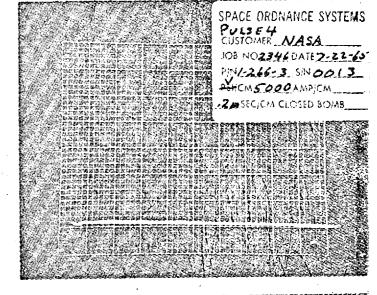


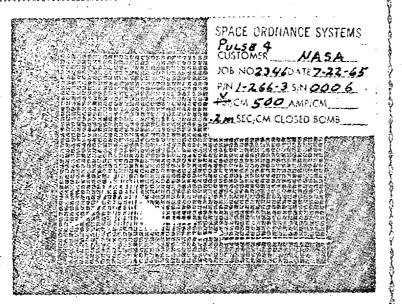


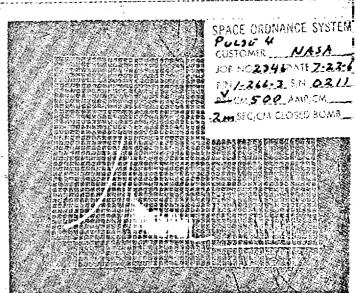


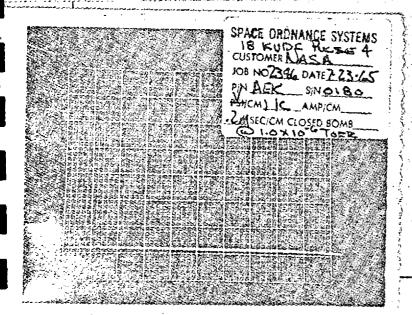
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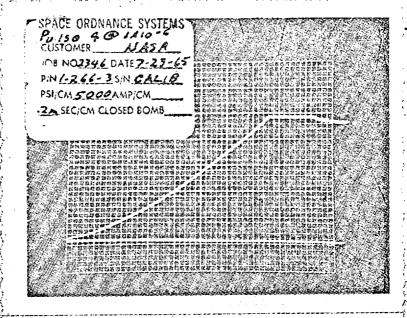


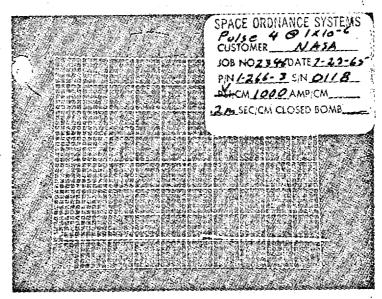


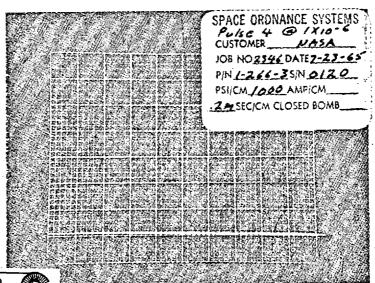


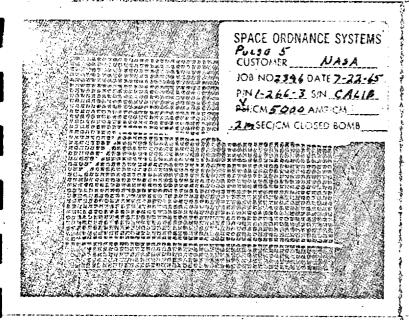


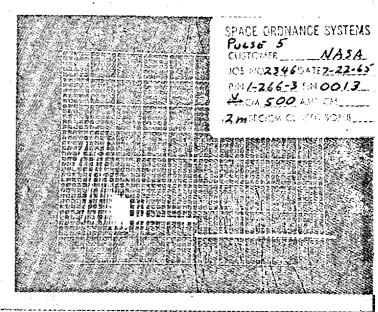


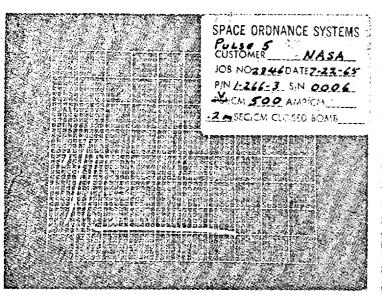


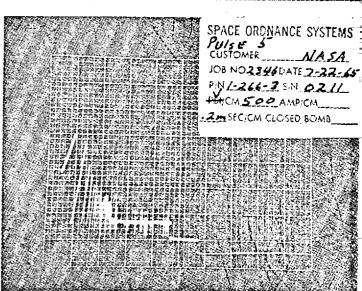


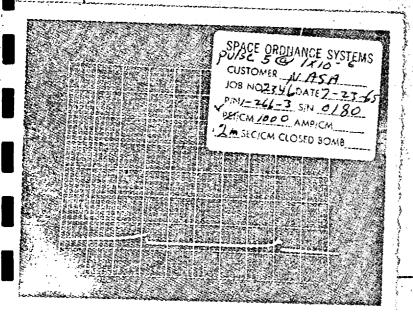




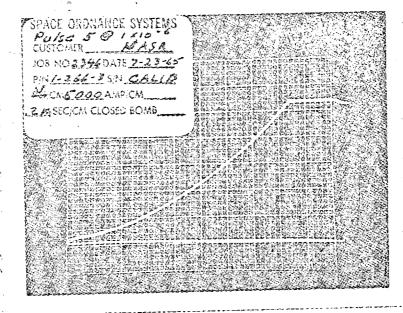


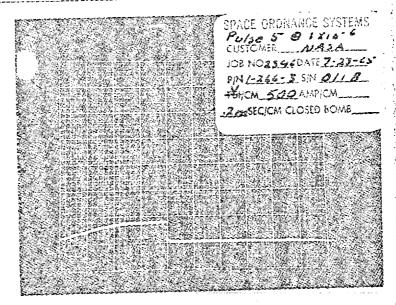


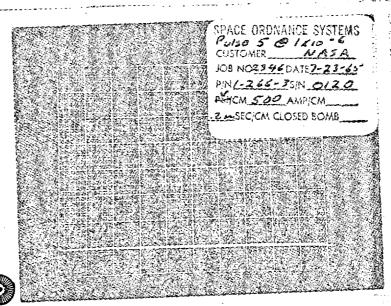










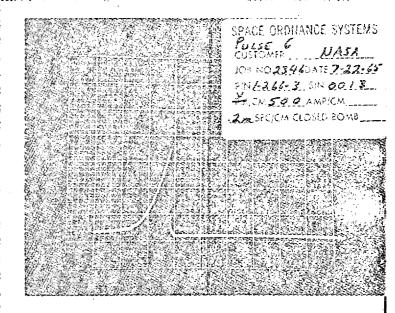


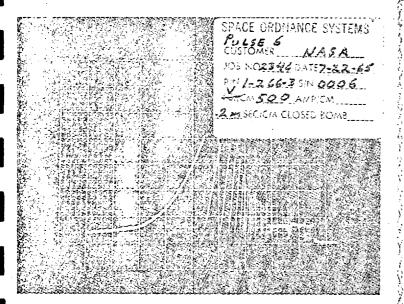
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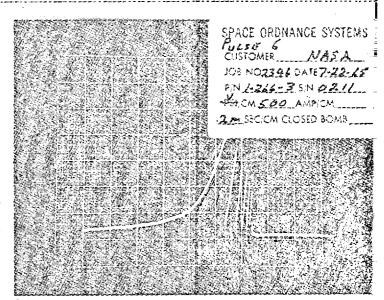
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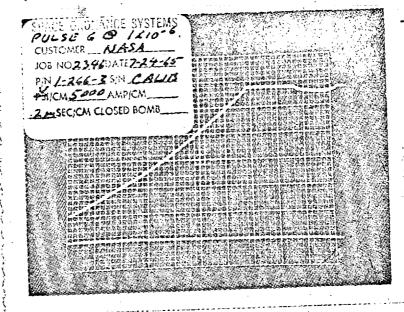
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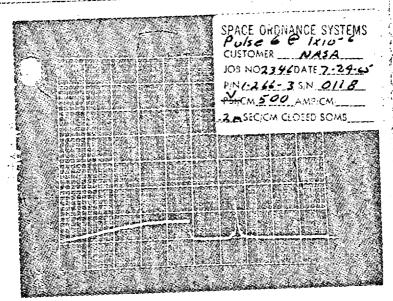
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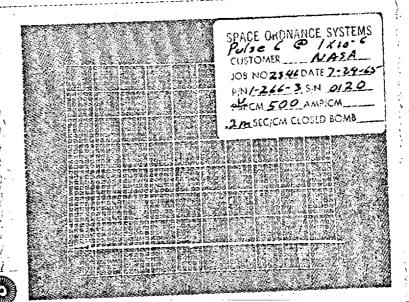


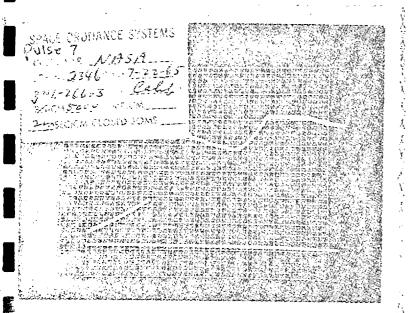


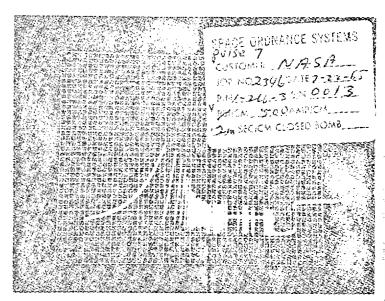


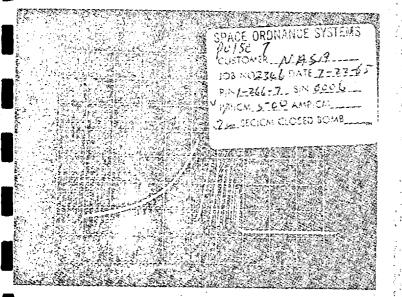


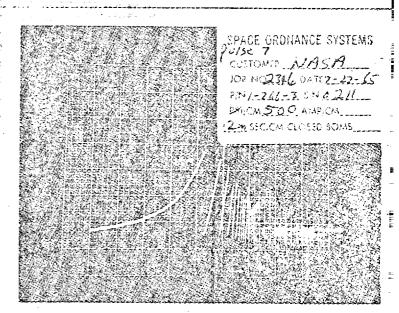


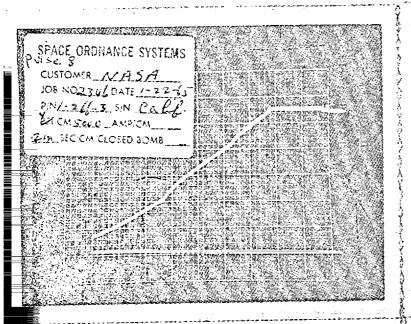


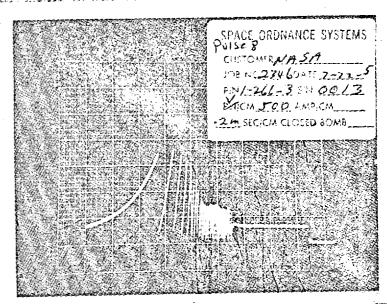


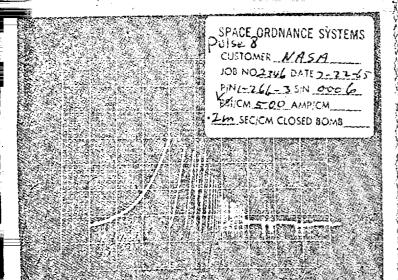


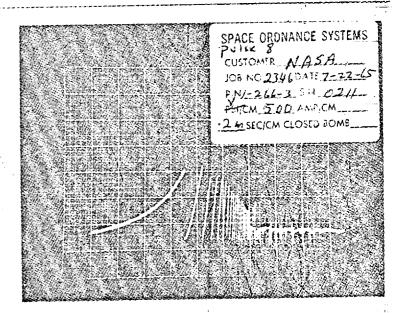


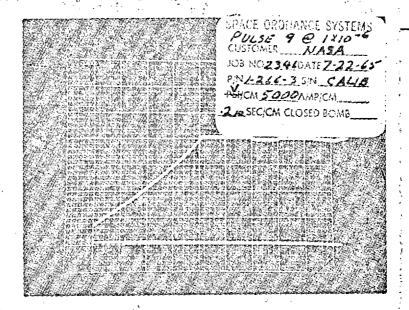


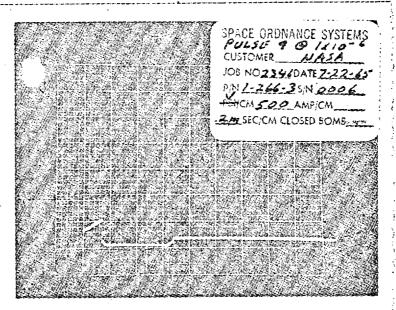


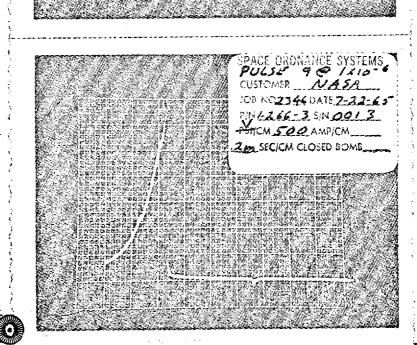


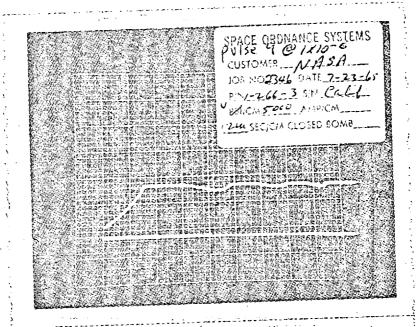


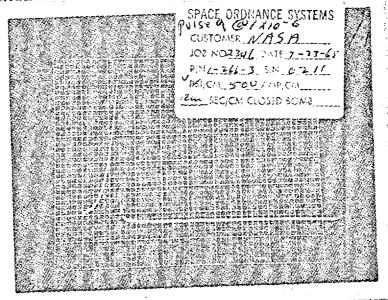


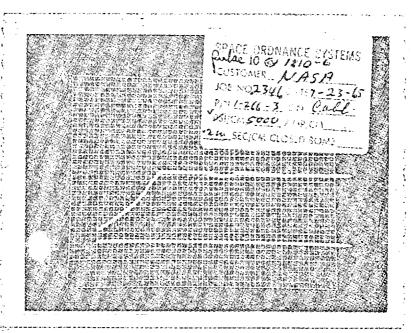


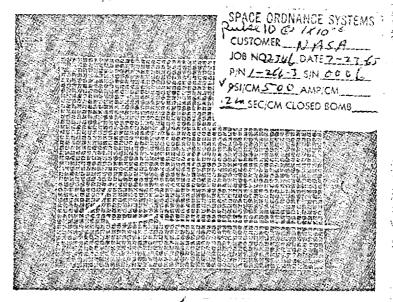








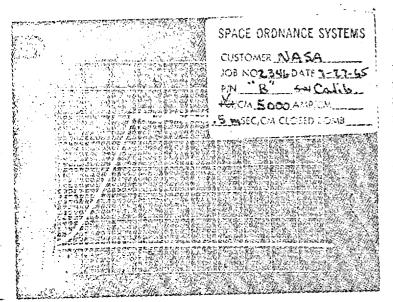


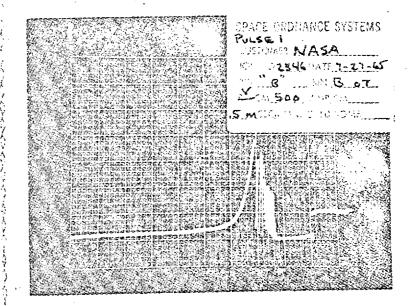


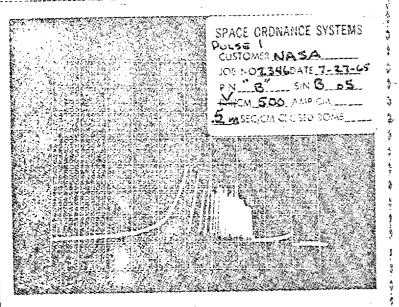
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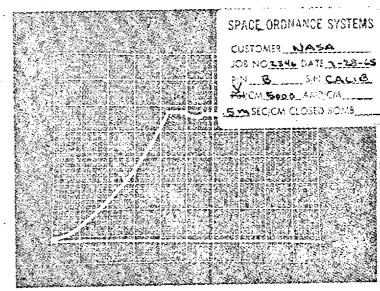
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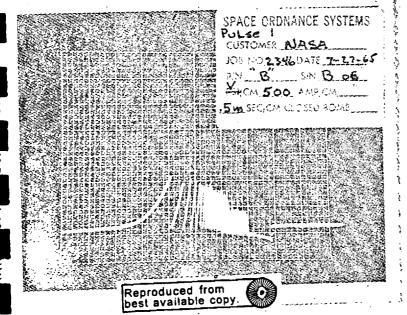
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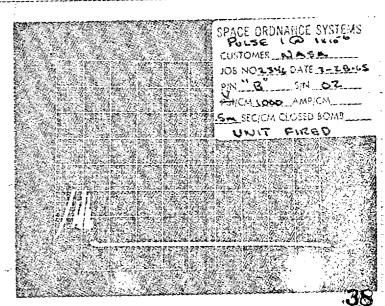












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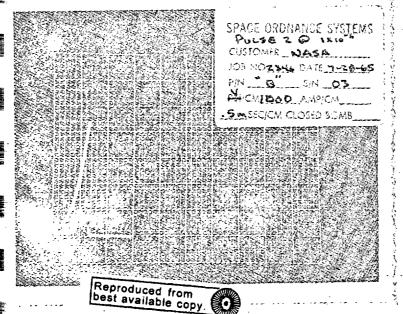
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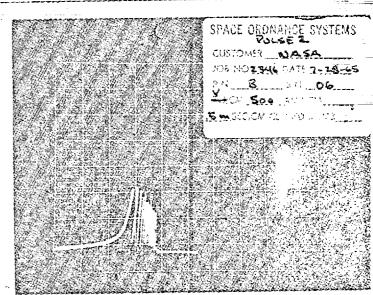
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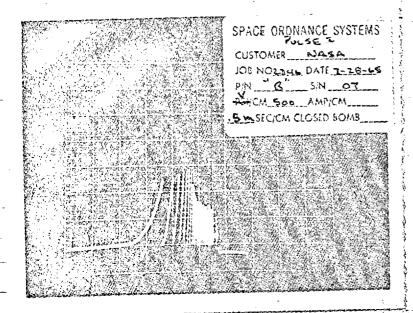
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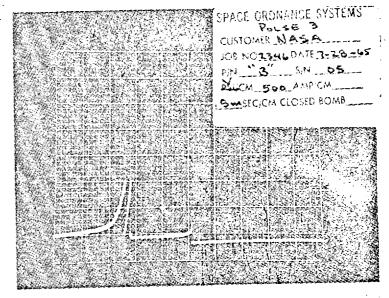
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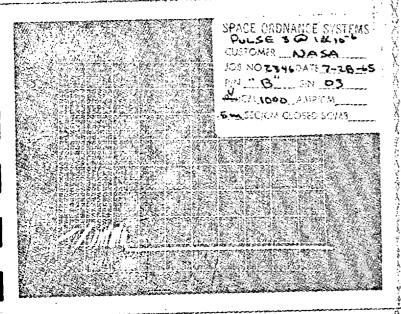
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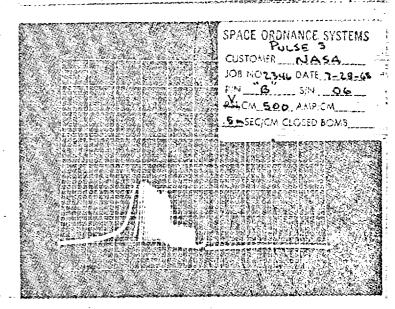


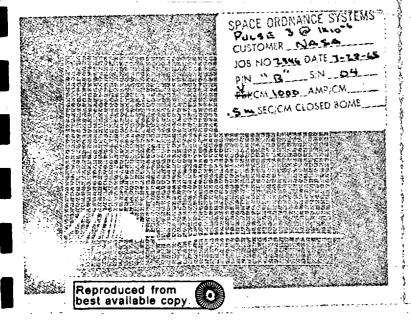


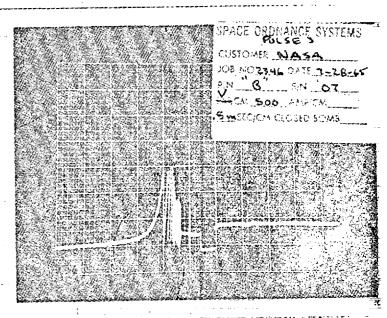


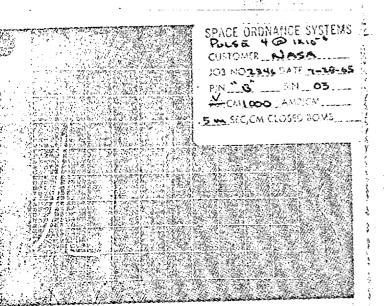


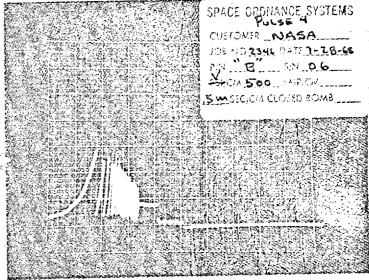


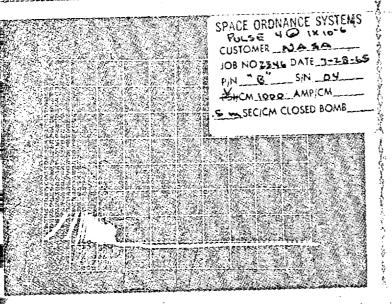


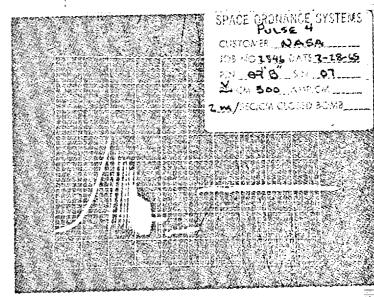


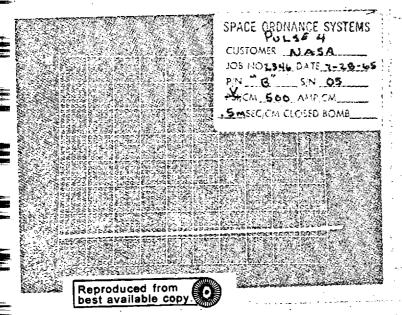


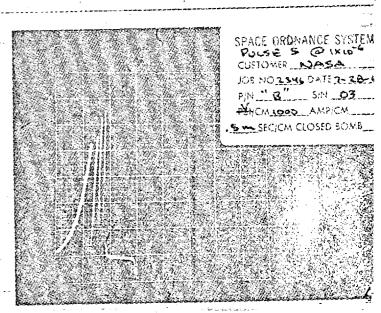








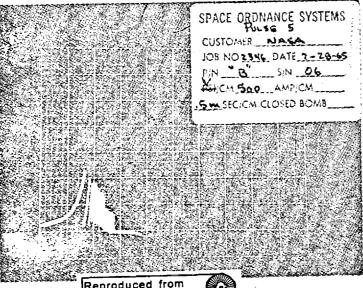


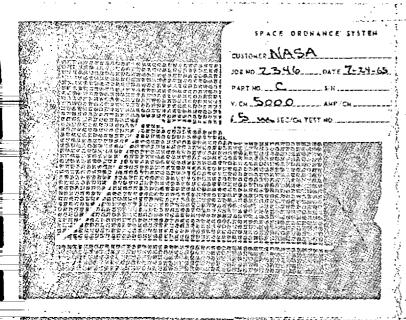


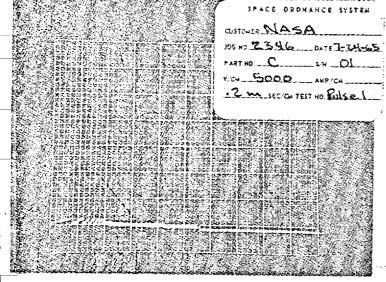
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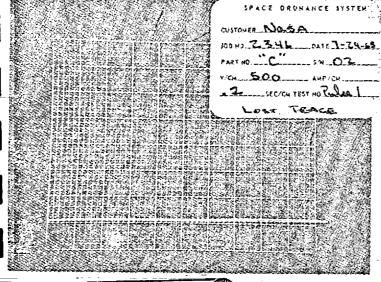
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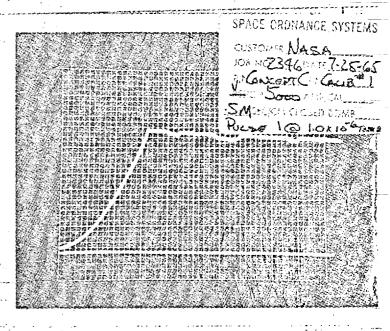






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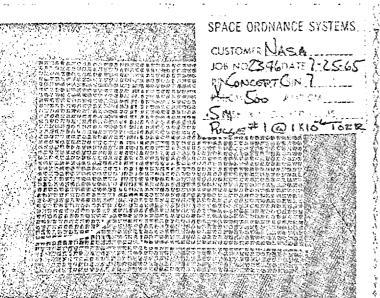
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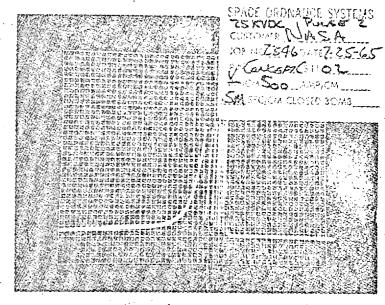


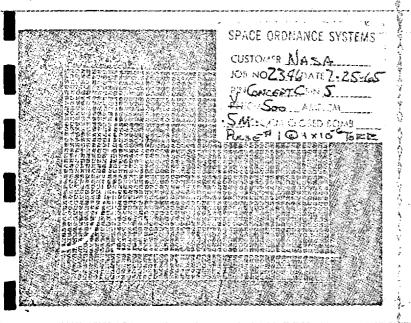
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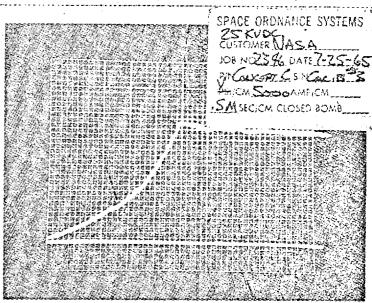
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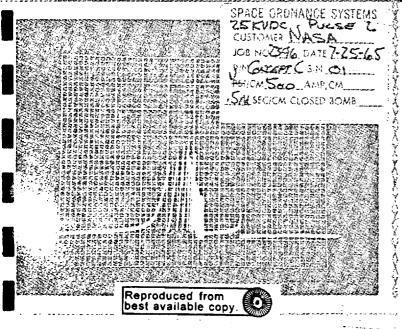
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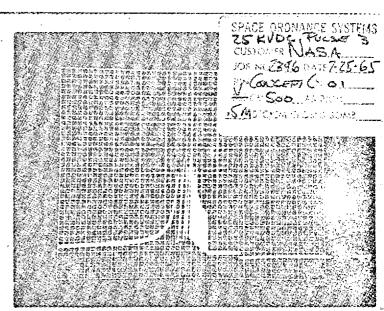






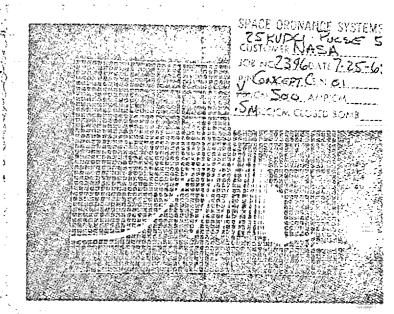


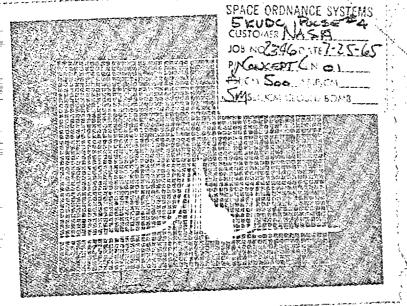




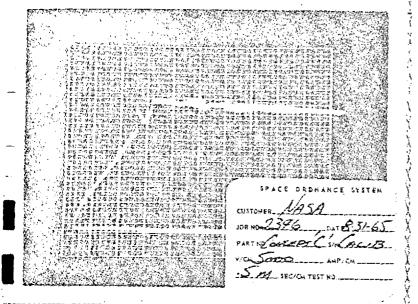
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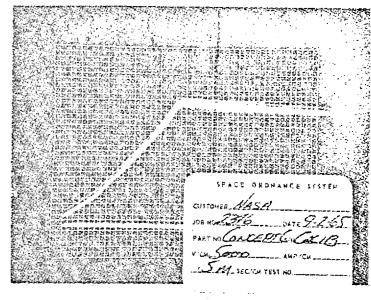
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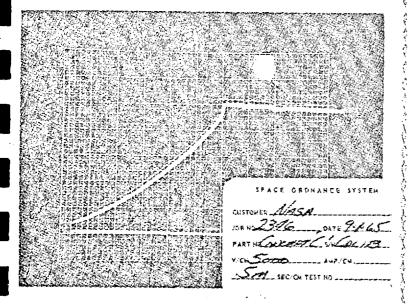


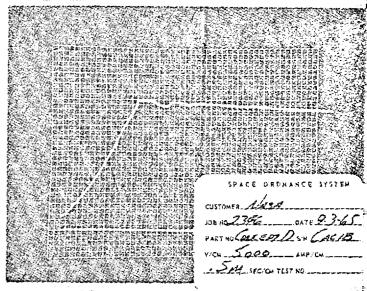


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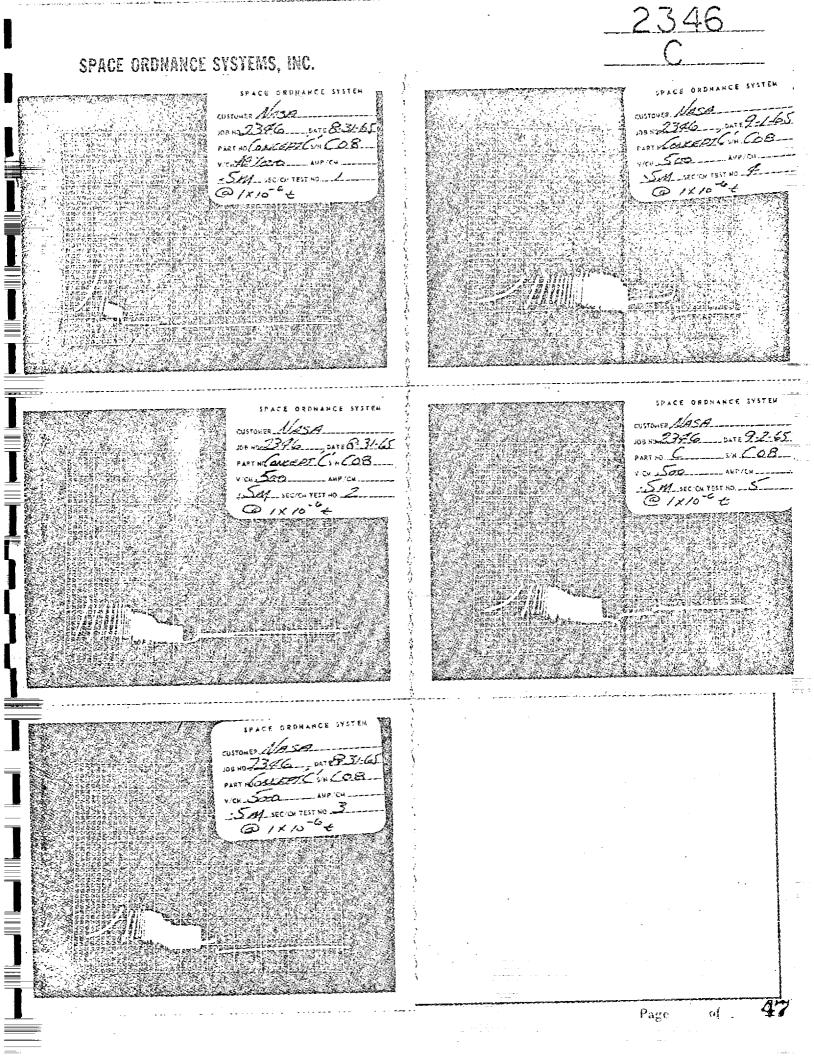








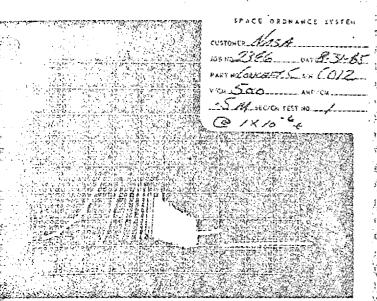
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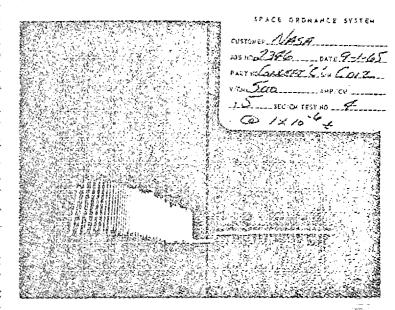


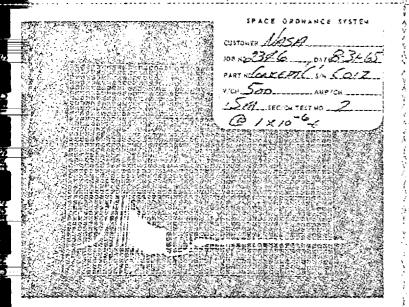
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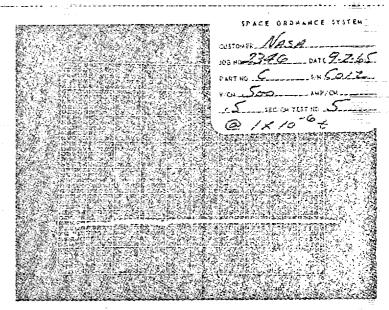
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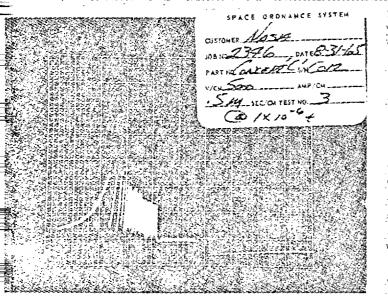
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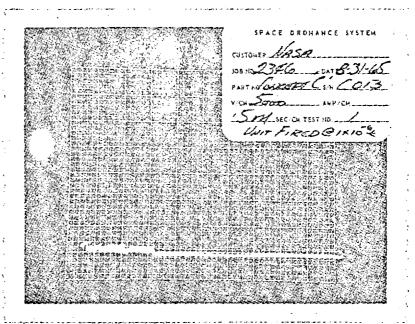






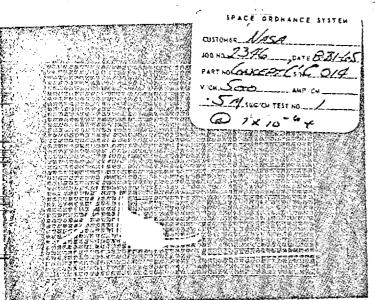
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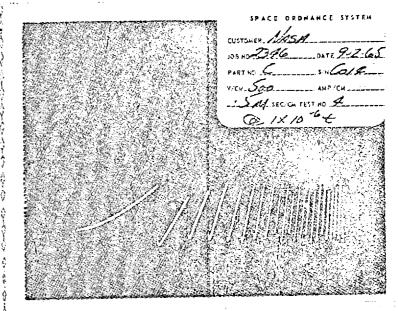
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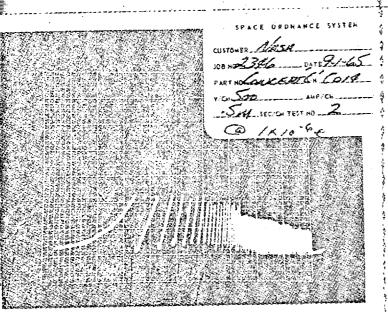


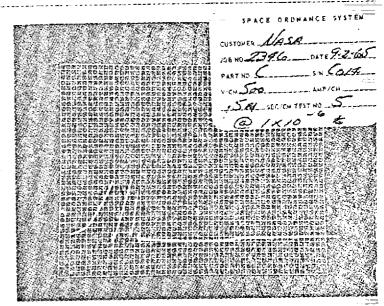
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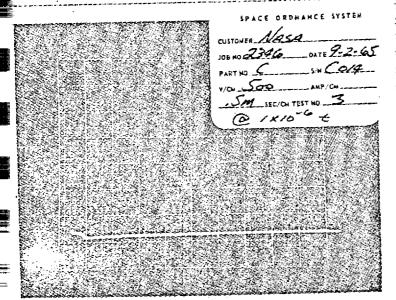
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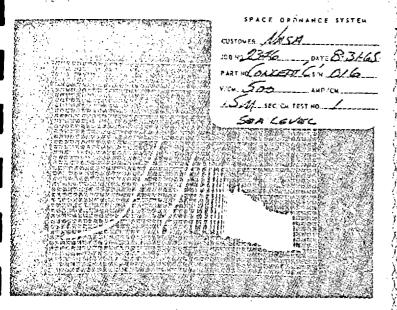


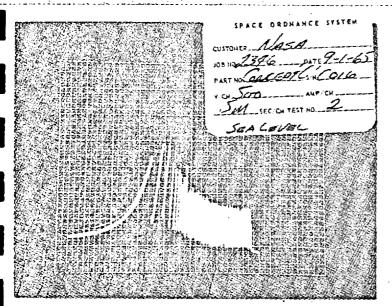


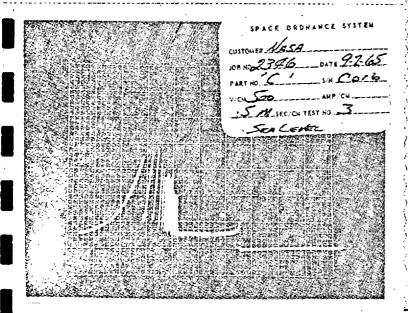






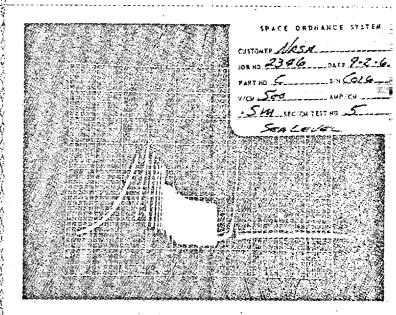






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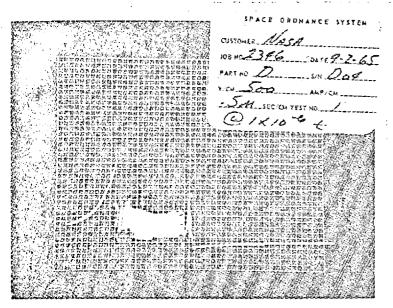
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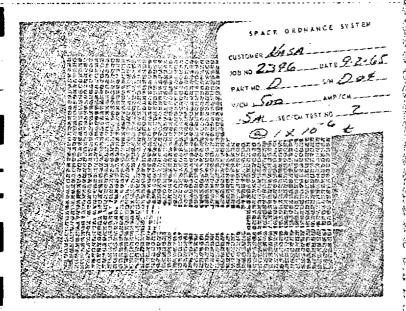
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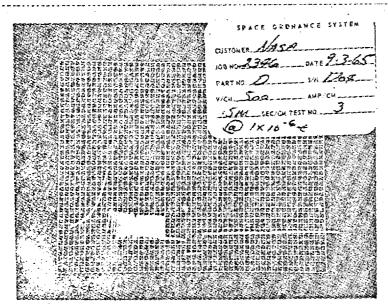
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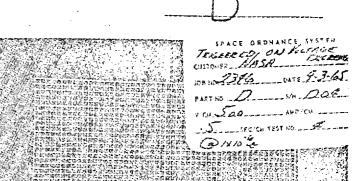
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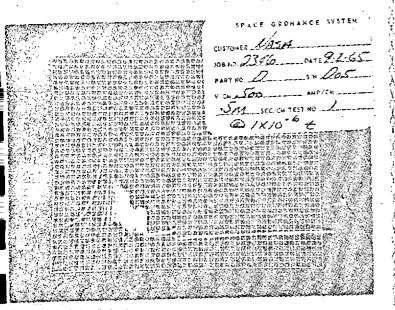
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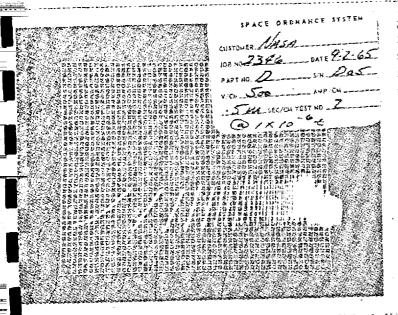
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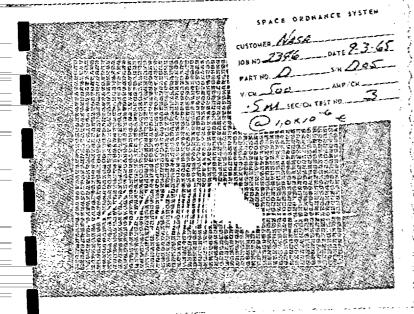
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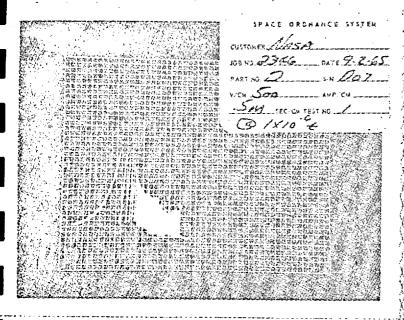
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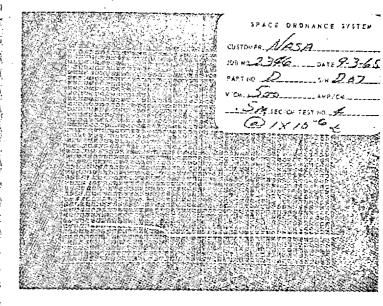
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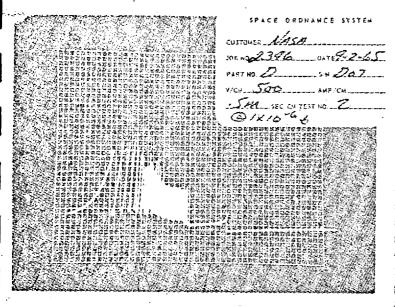
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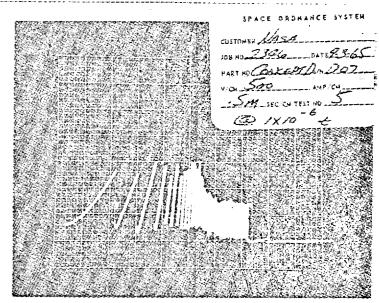
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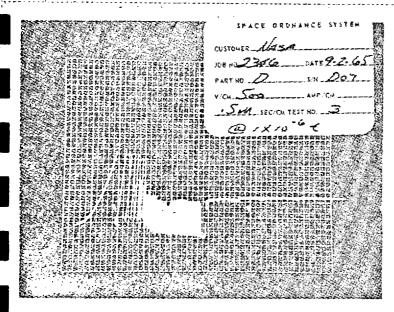
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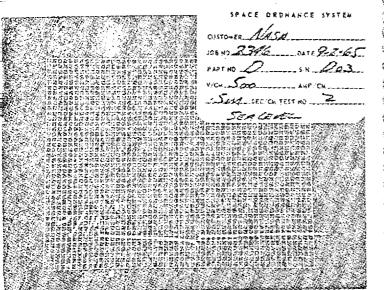


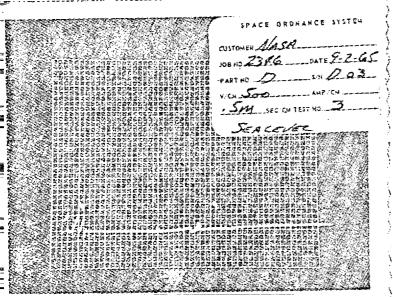






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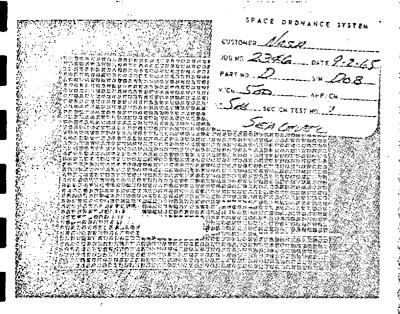


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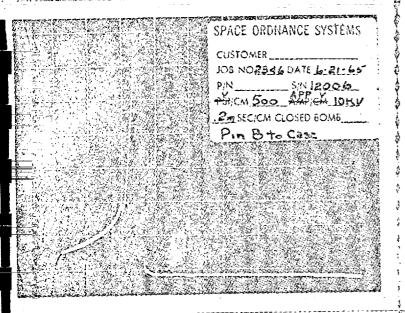
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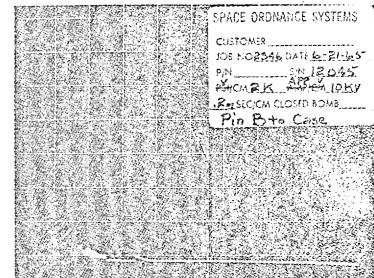
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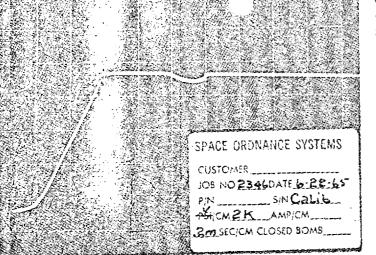
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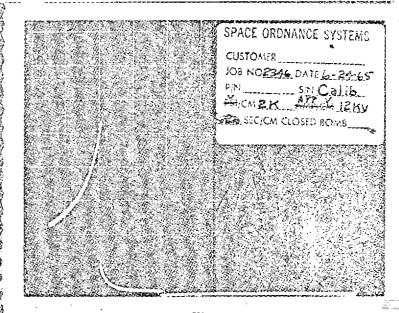
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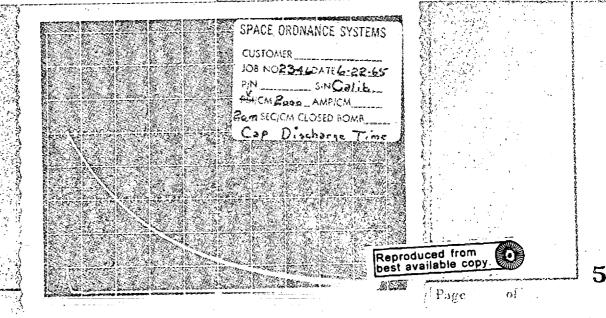
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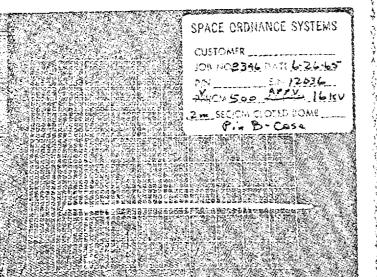
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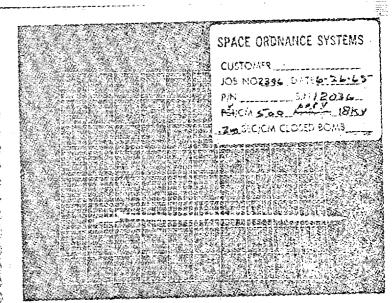
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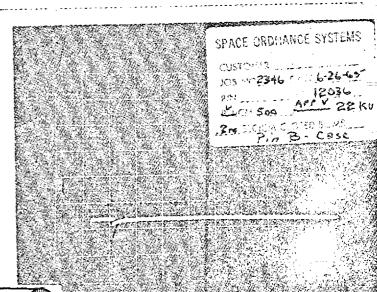
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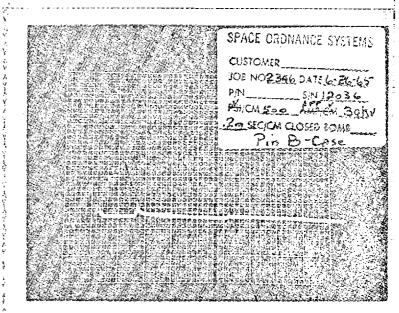


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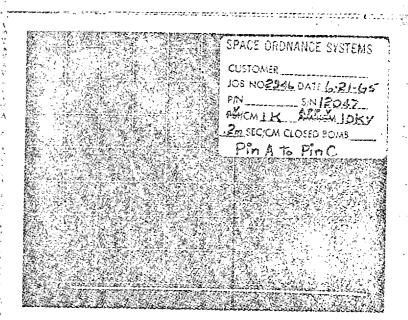
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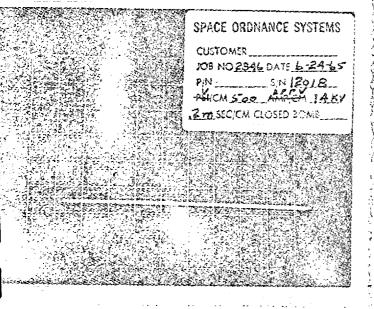
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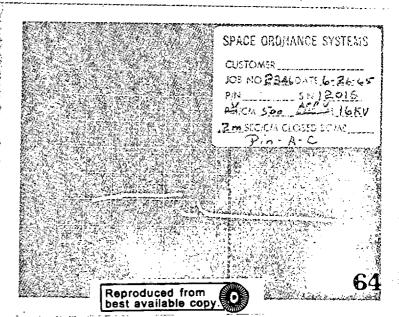
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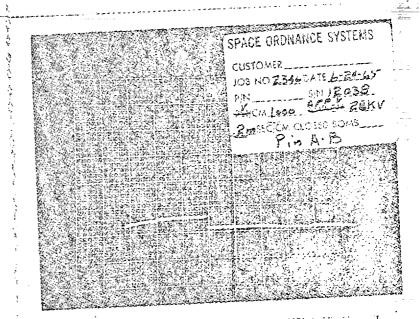
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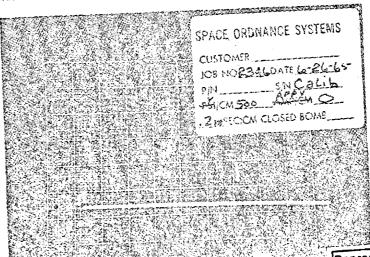
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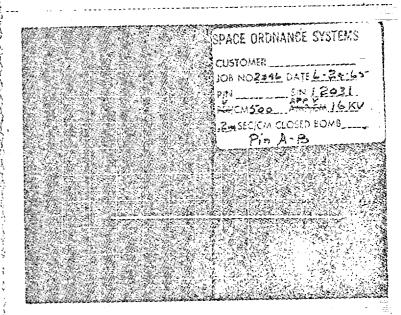
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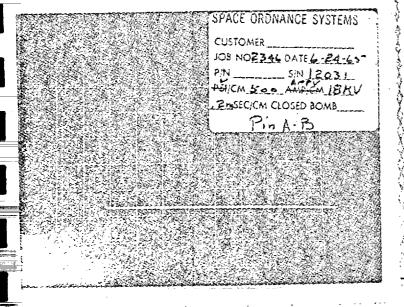
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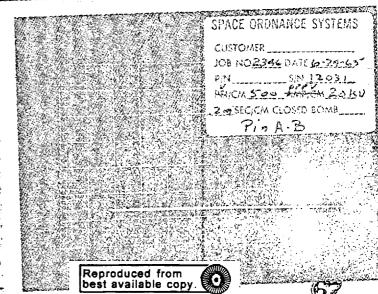
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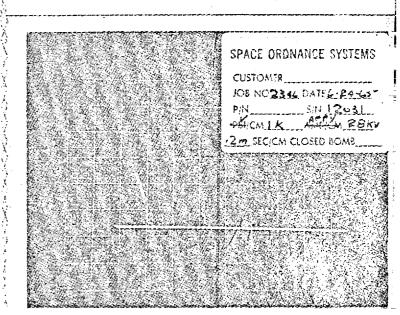
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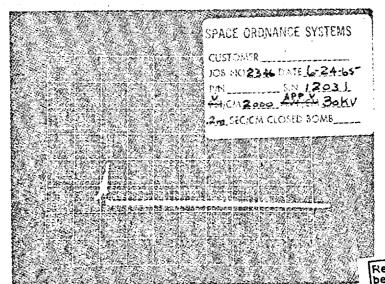
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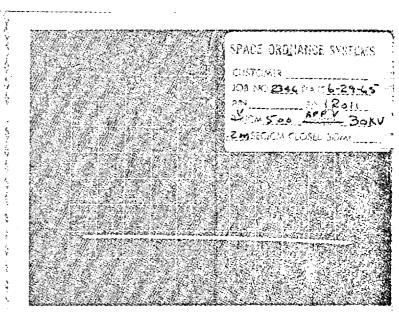
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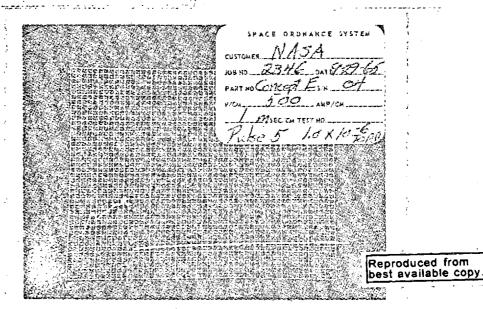
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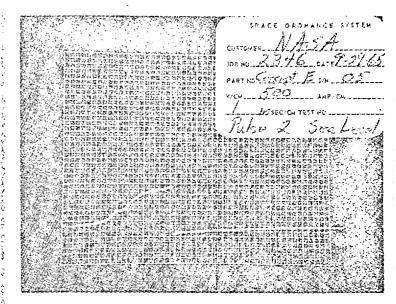
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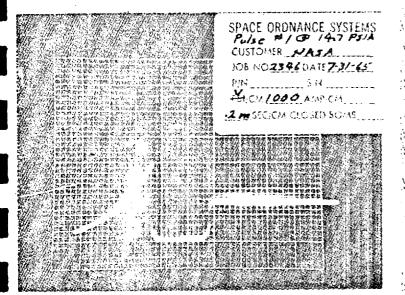
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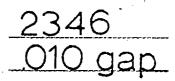
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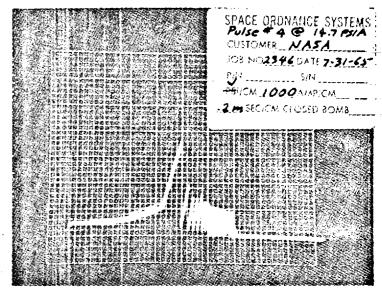
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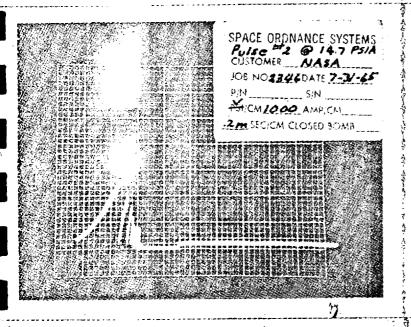
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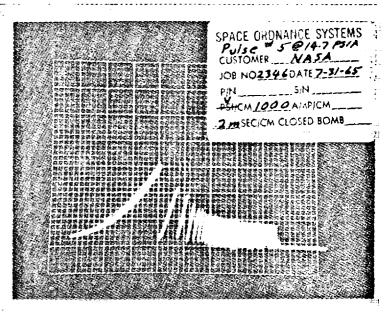
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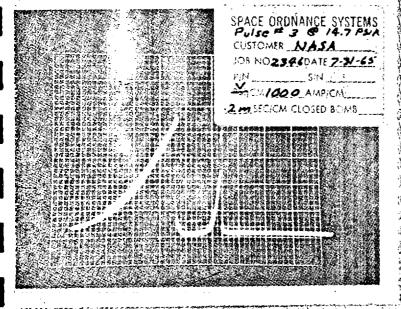


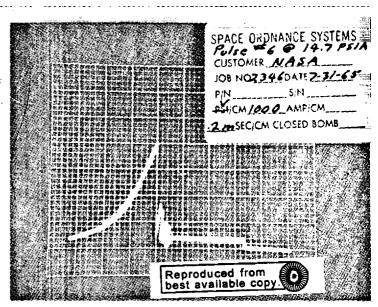




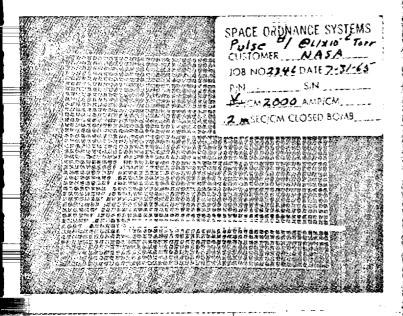


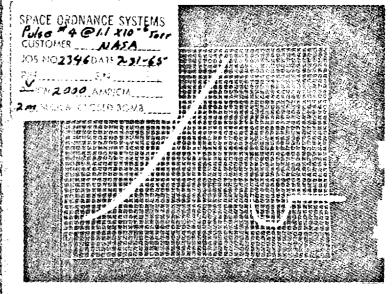


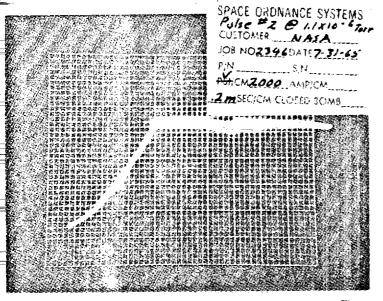


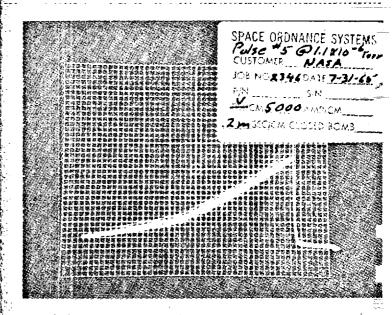


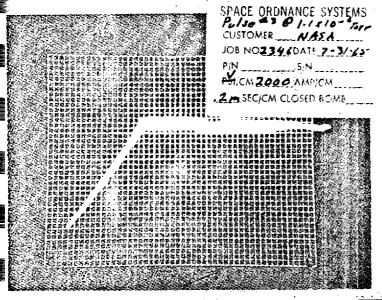
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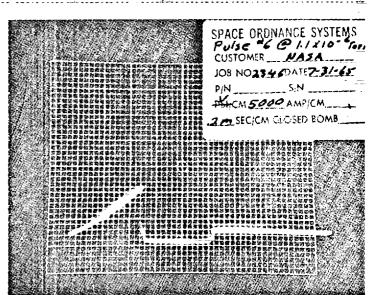


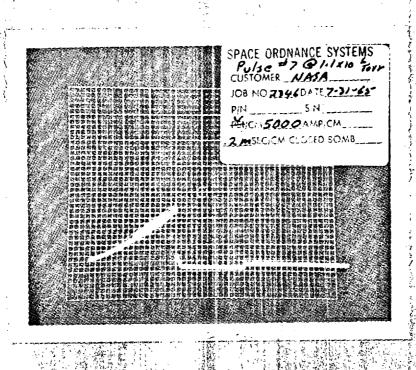












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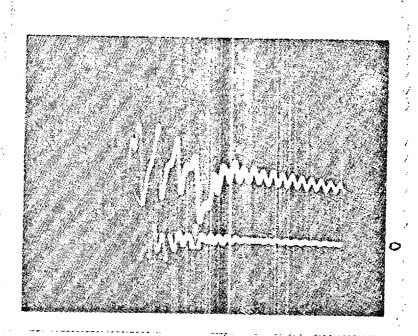
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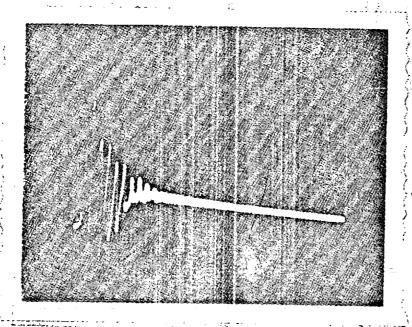
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SURGE VOLTAGES



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			9 K	1.105	1036	3.5 Ka	,058	1.894	4.856	
	5	25000							4 5 6 6	2700
		-	100K	1.106	1.090	2.5 Ka	.055	1.784	4.794	
		•								
			300 K	1.026	1.159	2 Ha	.068	177	4.5Pf	
C_1		9∞0.								4000
CCZIHK		12	50 K	1.027	1.143	3 Ku	,060	1.8 Pt	4.9Pf	
MYLAR	2	15000	22 K	1.073		4 Ha	000.	1.874	1000	2050
	. 3	15000	- C - N	1.00	1.1041	7 12	.000	1.073	コンドナ	2900
			3 K	1.023	1.139	6 Ha	,060	1,887	5.2 Pf	
	_4	20000								290c

3 Ha

1.022 1.138

1.025 1. 10 4 Ha

2.5 K

45 K

25000

,059

.052

5.3PF

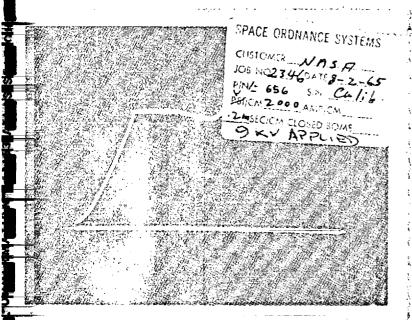
1.7Pf

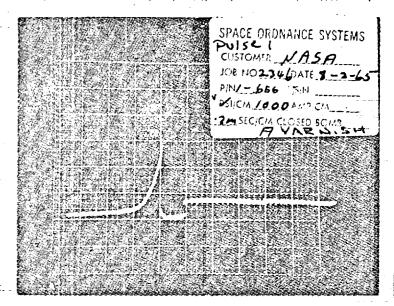
	ONTR. NO						E SYSTEMS, I TEST DATA S	INC. SHEET	. JOB NO	2346	
F .	1 1	_)ER	DWG. NO.		TOTAL ACC	EPT RI	
	TEST SPEC		TEST TE	СН			APPROVED			DATE	
	SERIAL	PULSE	VOLTAGE LEVEL	INSUL RES AT 500 VDC MEGOHMS	OF ERINGE-		CXELECTRIC STREGGENA NT SOCUAC MICROAMPS	INTERBRIDGE RESISTANCE CIRCUITS A-BTO C-D	INTER BRIDGE CAPACITANCE ATONE MEGA- CYCLE CIRCUTA A-R TO C-D	PIN TO CASE CAPACITANCE ATONE MESA CYCLE SHOLTED PINS TO CASE	BREAKDOWN
-				100 K	968	972	4 Ha	,051	1.6Pf	4.474	
	B		25000	80 K	913	363	4.0 Ha	4.405	23Pf	5.6Pf	3150
				OOR	1213	7.0		3,19.3			
				240 K	1.002	ا علىك	4 Ha	, O Sc	1.784	4.484	2700
	<u> C </u>		25000	300K	i.066	i e52	4 Ha	4.412	2.094	5.689	3700
1											
	<u> </u>				-						
			0.5	70 K	1.82	1.134	3 Ma	.053	1.5PF	4.4.7-4	3200
	D	· · ·	25000	140K	£30.1	1.134	3 Ha	.068	1.994	5.489	3200
					-					<u> </u>	
	E	<u>{</u>	05000	30K	981	1041	A-Ha	.054	1.6Pf	4.4 Pf	2200
			25000	DOOK	932	1.043	35/a	720،	2.0Pf	5.1Pf	
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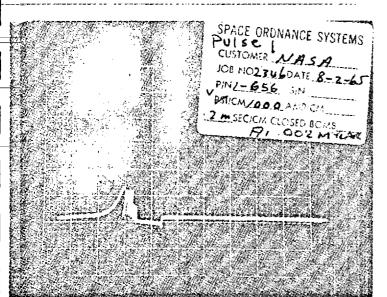
CONTR. NO			SPA(FINAL	CE ORD	NANCE TANCE	E SYSTEMS,	INC. SHEET	JOB NO.	2346	
SPEC OC	52 MY		ITEM RAL					TOTAL AC	CEPT R	EJECT_
SERIAL MUMBER	PULSE	VOLITAGE	INSUC RES AT 500 VDC MEGOHMS	BRINGE-	NC C	CARLECTRIC SYRENGA+ AT SOUNC MICROAMPS	HYERBRIDGE RESISTANCE CIRCUITS A-15 To C-D	HITER BRIDGL CAL CITANCE NONE WEER- CACLE CIRCITS A-P TO C-D	TO CASE PACITA VCE SNE MESA LE SHOLTED S TO CASE	BREAKDOWN
A2		25,000	40 K	1.085	.965	4 Ha	.050	1.884	4.c Pf	105
		L 3,000	13 K	1.062	.ગ્રહા	2.5 Ha	.055	1.6Pf	4.4Pf	182
A =		05 00-	50K	1.052	1.637	4-Ка	.050	1.8 P4	4.574	
_A3		25,000	21K	1.054	1036	3 Ha	.055	1.784	5.074	23
			80K	1.052	1.050	4 Ha	.052	1.8Pf	4.571	
-44		25,000	20K	1.090	1043	3.Ha	.055	1.8 Pt	5.084	270
A		0.5	300 K	1.466	1041	4 Ha	.054	1.671	4.47{	
A B		25000	1000 K	1.069	9 <i>č</i> o 1	3.5 Ha	.058	1.7 Pf	4.894	265
·										
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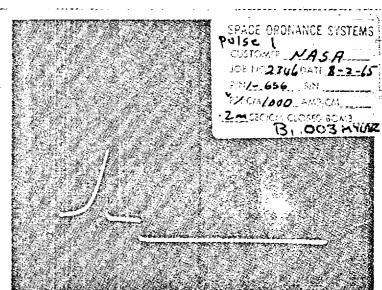
	.C. NO ONTR. NO			FINAL .	ACC EP	TANCE	E SYSTEMS, TEST DATA:	SHEET	JOB NO.	2346	·
	SPEC .OO	3 MYL	AR	ITEM PM	HEN	DER	DWG. NO.		TOTAL ACC	CEPT R	EJECT
	TEST SPEC		TEST TE	Сн			APPROVED			DATE	
	SERIAL NUMBER	PULSE	VOLTAGE	INSUL RES AT BOO VDC MEGONIMS	B BRIKEE-	12	DYFLECTRIC SYREMGINA NT 500VAC	INTERPREDEE	HITER BRIDGE CAPPRITONIE NONE MEGA- CALLE CIRCUTS A-F. TO C-D	PIN TO CA . 3. CAPACITANCE ATONE MEGA CYCLE SHOLTO PINS TO CASE	BREAKDOWN
				BOOK	1.054	1.074		.055	1.789	4.2PF	000
	B2_		25000-	~	1.053	1.070	35 Ha	.055	1.7 Pf	4.894	- 900
L †											
	B3		25000	250 K	1 63	7,92		.052	1.78t	4.3 Pf	2600
				500 K	1.099	<u> </u>	3.5 Ka	.051	1.7Pf	4.794	
		1				[!				
		,							1206	4 2 0 (
	B4_		25000	35 K	1.0607	951		055	1.7 Pf	4.3P4	2800
				400K	1.c34	942	2.5 Ma	.053	1.794	4.774	
	<u> </u>	T :				<u> </u>]	
				05 - 17		220		05.0	1.784	4.2Pf	-
	BE		25000	250K	1057	1		.052			2700
		<u>i</u>	:	250 K	1.049	976	2.5 Ha	,053	1.5Pf	4.5 P4	
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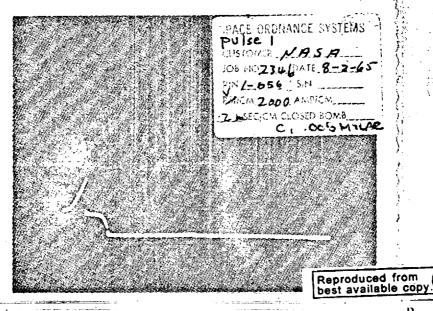
	P.O. NO C <u>ontr. No</u>			FINAL .	ACCEP	TANCE	E SYSTEMS, TEST DATA	SHEET		234	
	SPEC OC				He				TOTAL AC	CEPT R	EJECT
	TEST SPEC		TEST TE	Сн			APPROVED_			DATE	
	SERIAL NUMBER	PULSE	VOLTAGE	INSUL RES AT 500 VDC MECOHMS	CANCE-	TRESISTANCE 0	Cyplectric Strength NT 500VAC	WESTSTANCE RESISTANCE CIECOITS A-ESTO C-D	MITTER BRIDGL CAPACITANCE ATONL MESA- CACLE CIRCUTA A-P. TO C-D	17 17 17 17 17 17 17 17 17 17 17 17 17 1	BREAKDOWN
	C2		25000	SCK	1.094	1050	4,41a	,050	1789	5.2 Pf	03.00
:			123000	5K	1.094	1.043	3 Ha	.055	1.7 Pf	4.674	2300
	-C-3	ì	35000	300K	 	•	4 Ha	.047	1.7 Pf	5.2Pf 4.6Pf	2400
	Cq		25000	30K		.957 .955	2 Ha	.055	1.774	4.6 Pf	2900
	C5	- 1	25ccc			1.090 1.080		.056	1.7 Pf	42Pf	-3300
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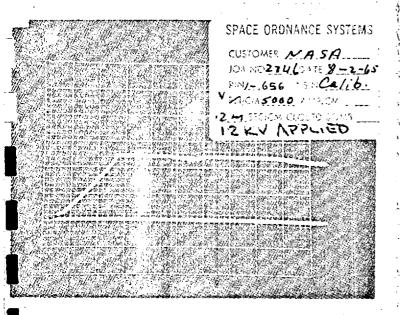


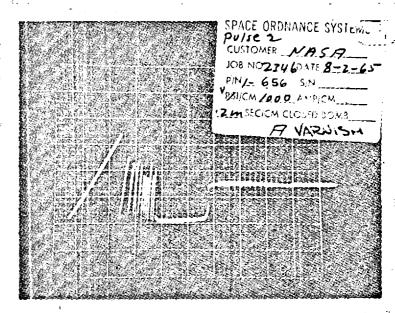


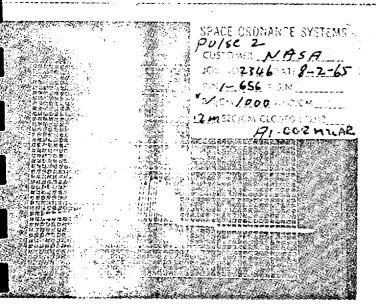


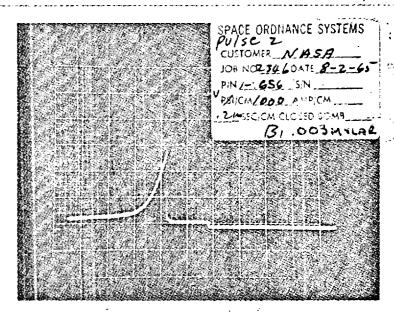
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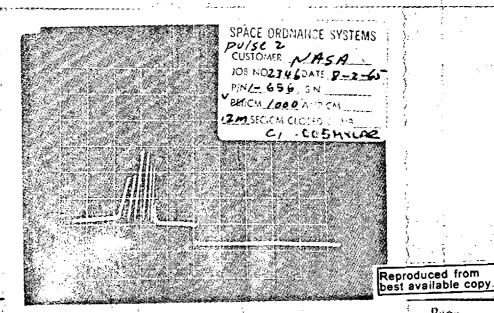
SPACE ORDNANCE SYSTEMS. INC.



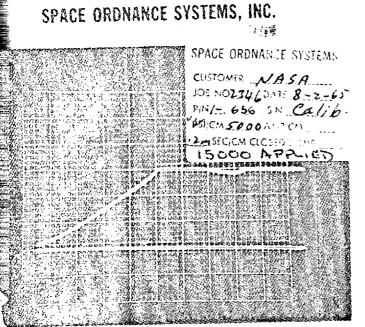


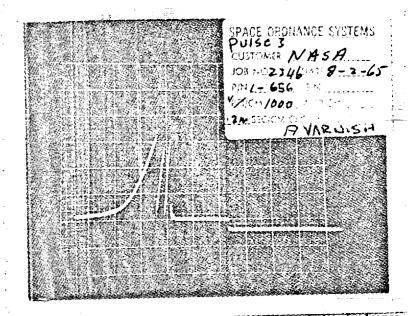


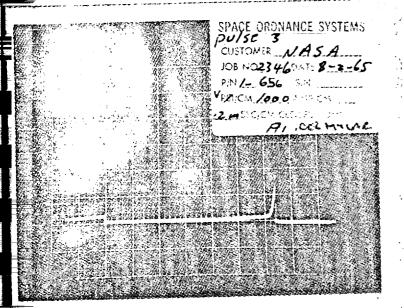


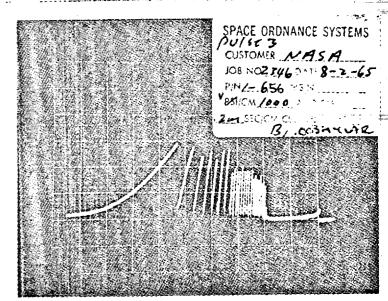


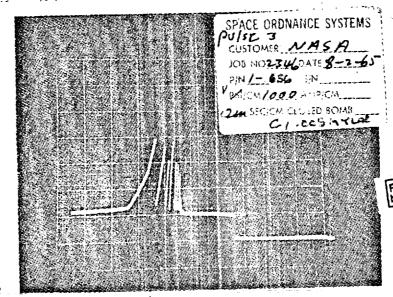
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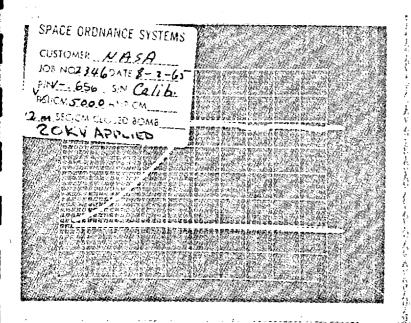


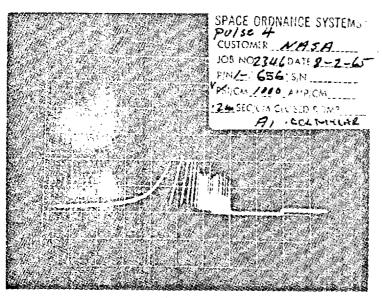


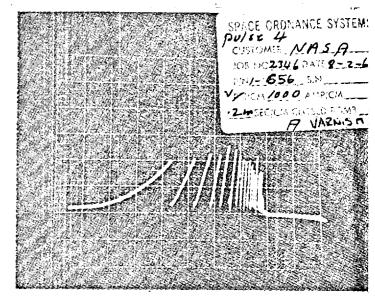


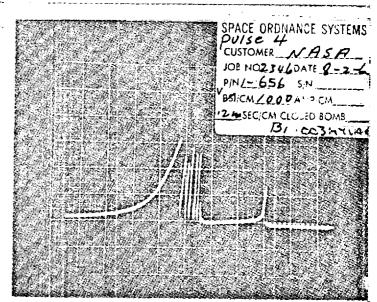


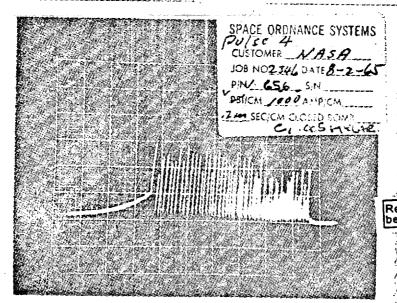
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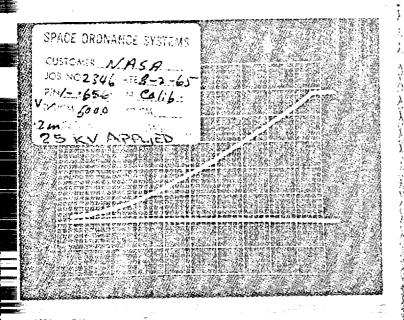


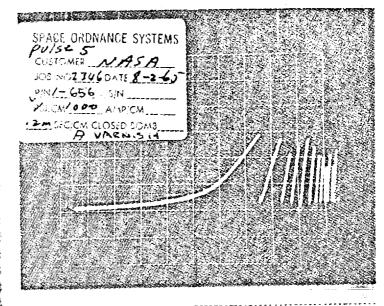


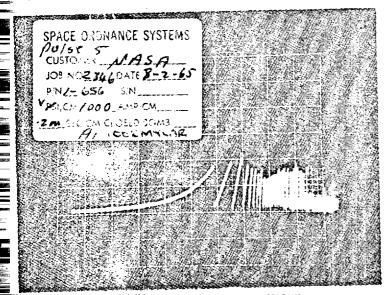


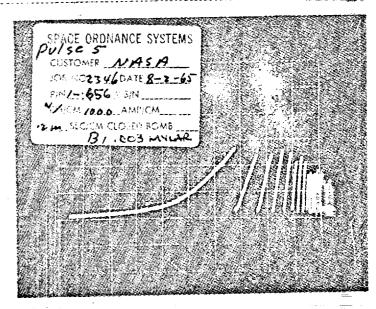


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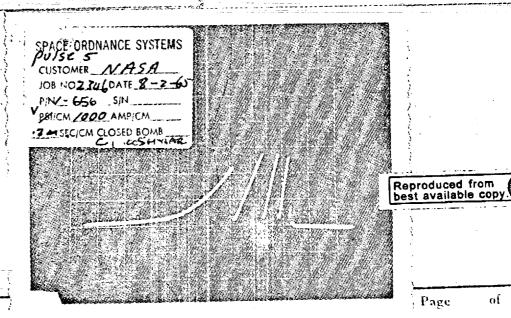


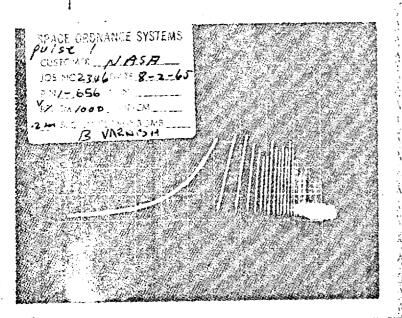


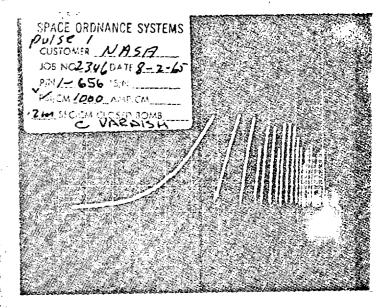


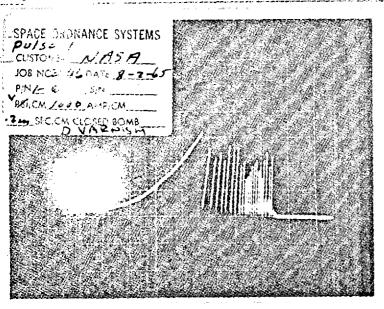
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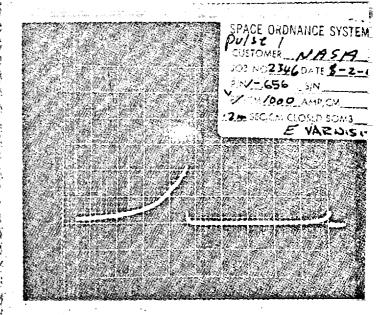
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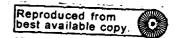


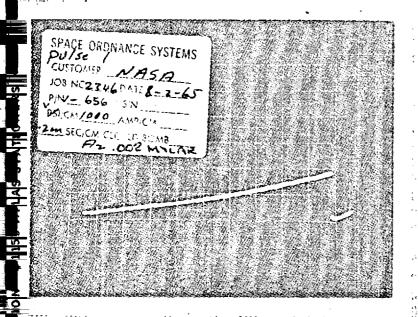


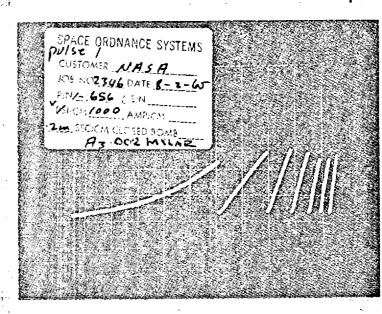


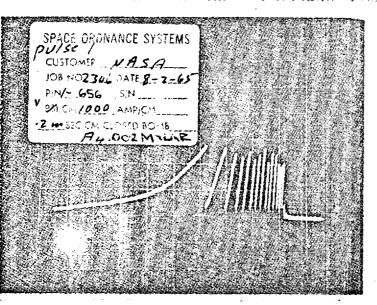


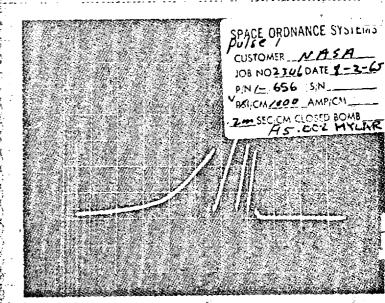




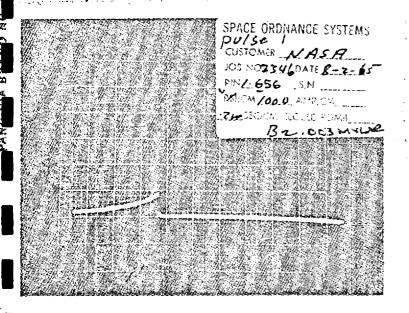


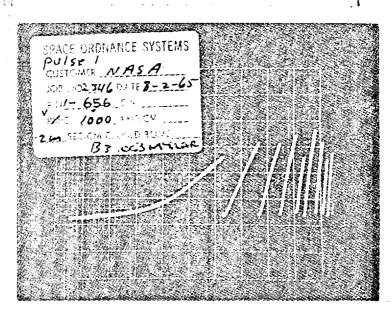


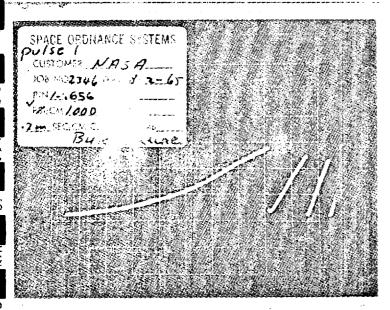


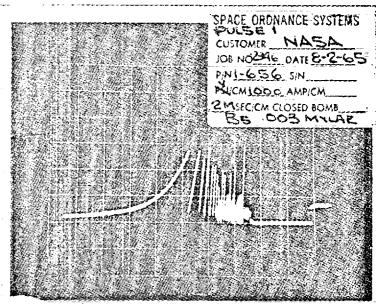


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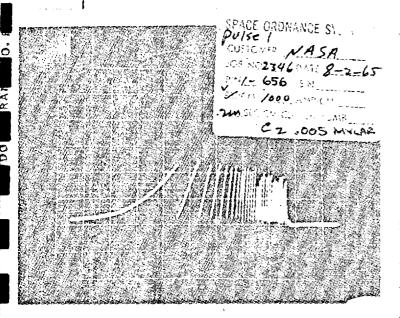


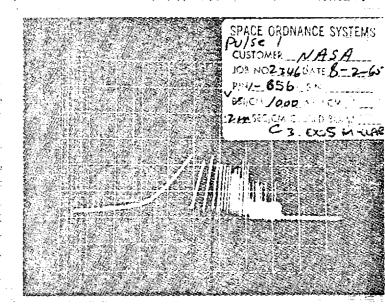


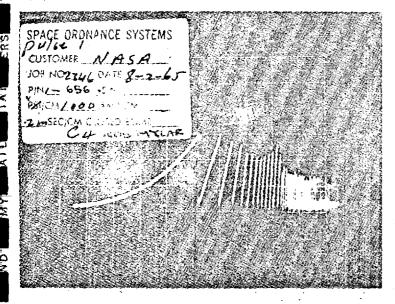


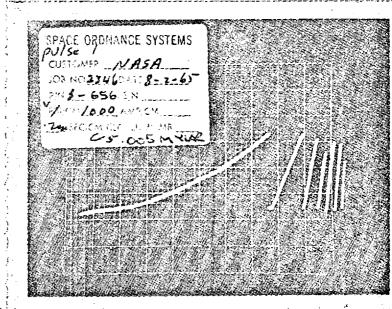
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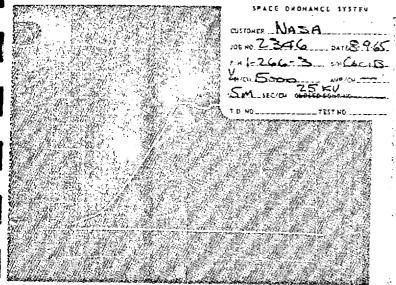


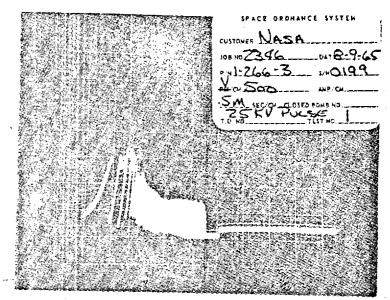


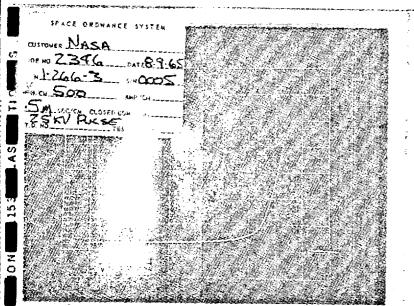


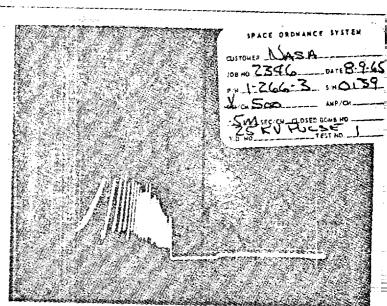


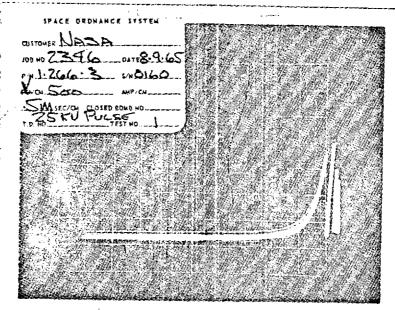
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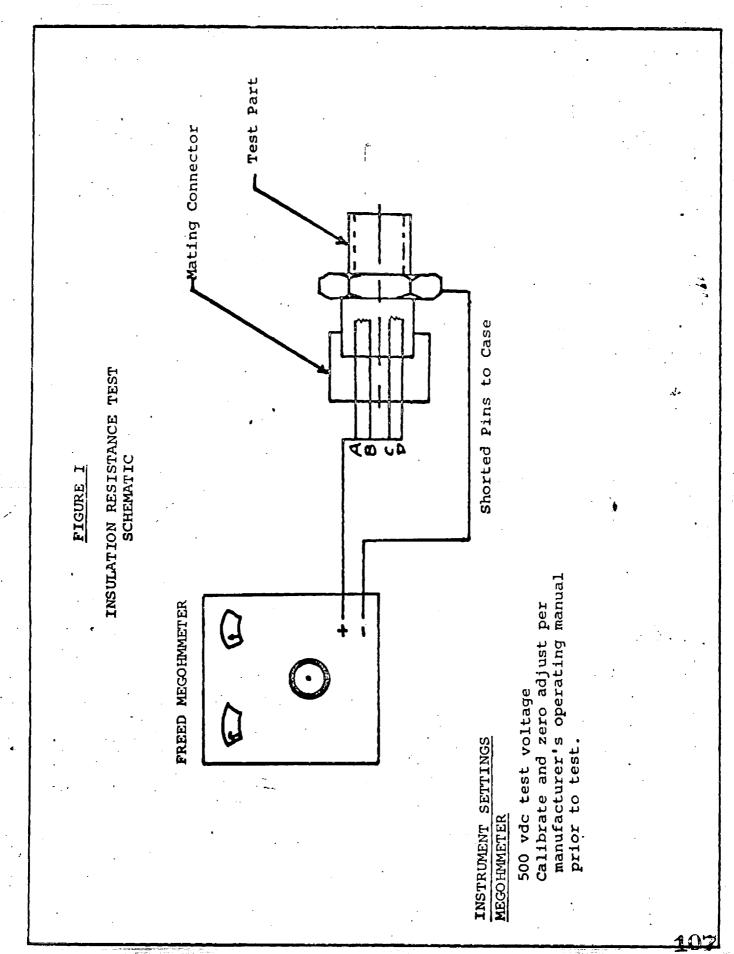


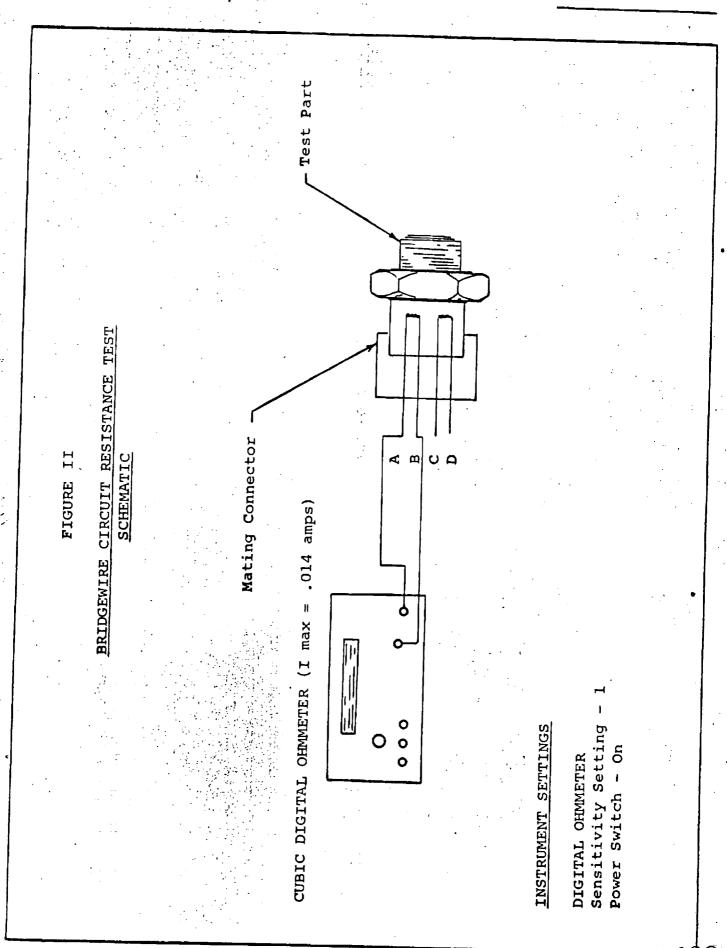


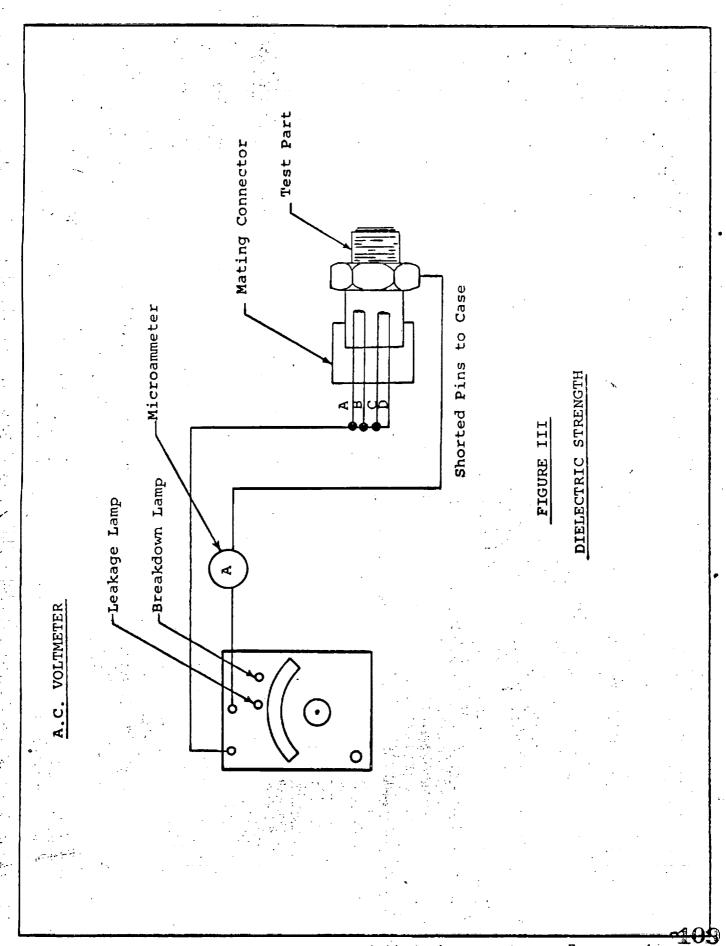




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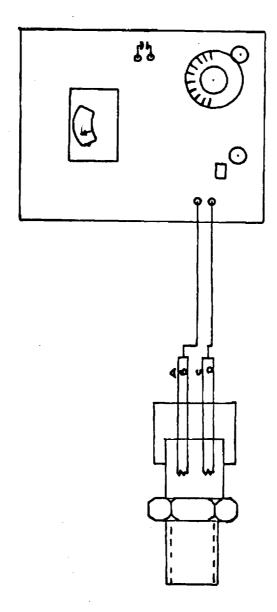
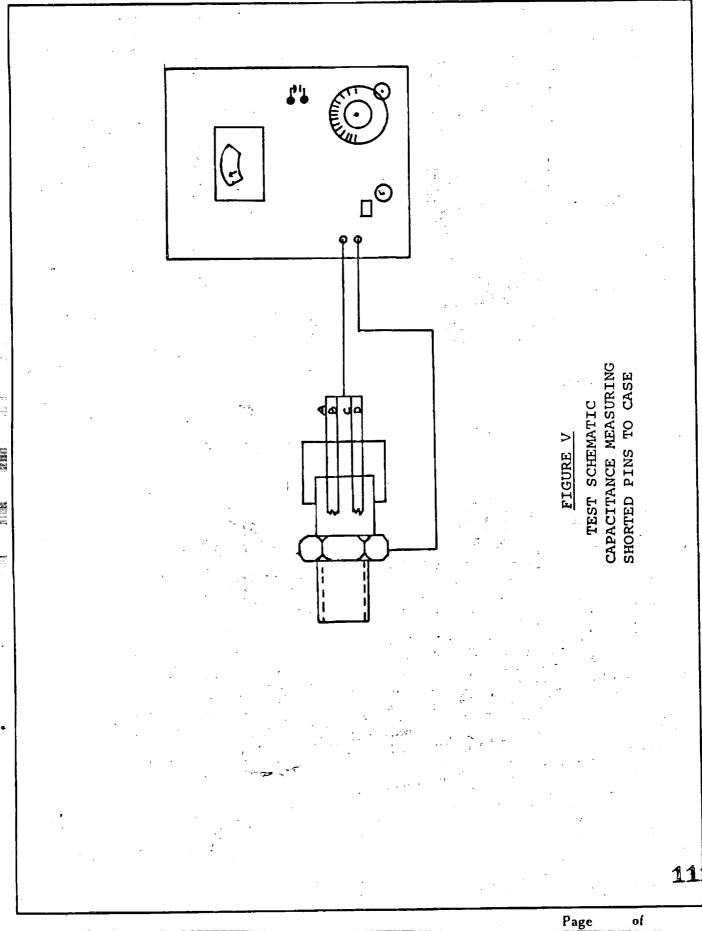


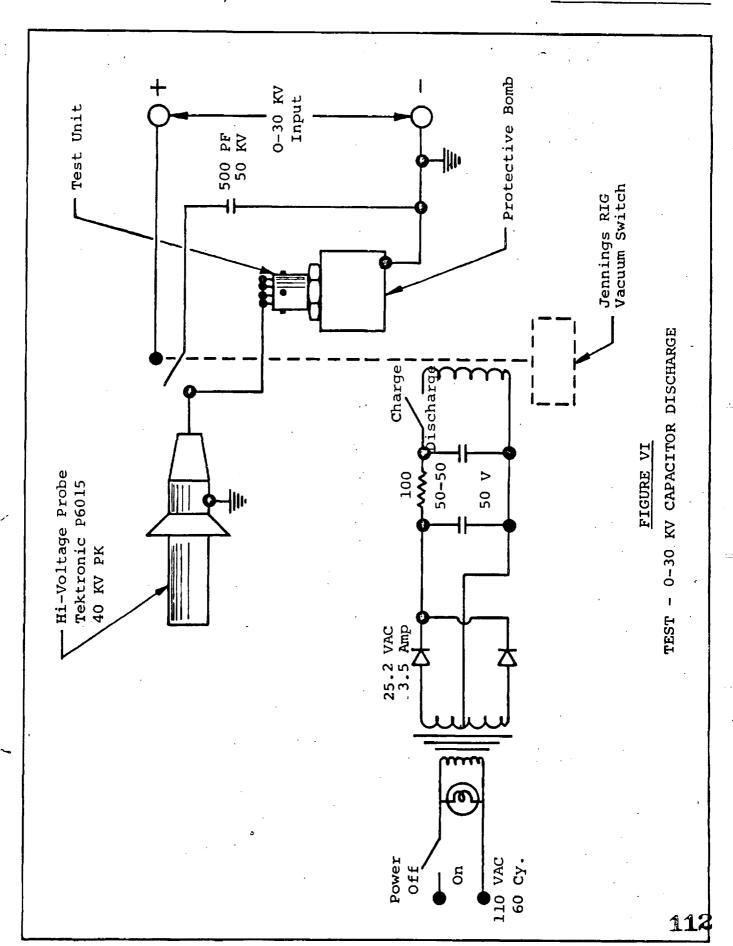
FIGURE IV

TEST SCHEMATIC
CAPACITANCE MEASURING
CIRCUIT TO CIRCUIT

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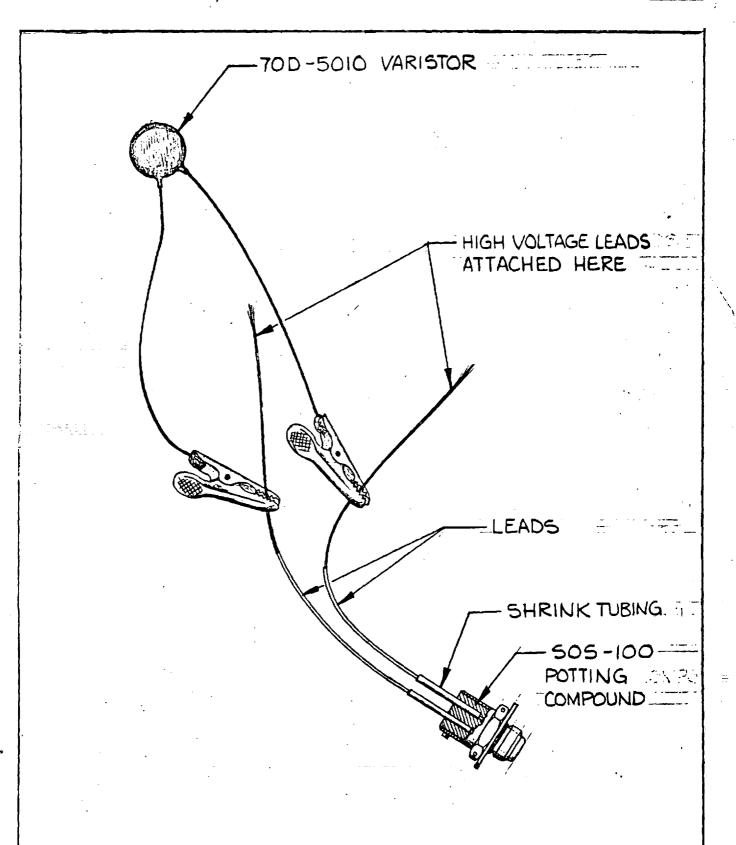


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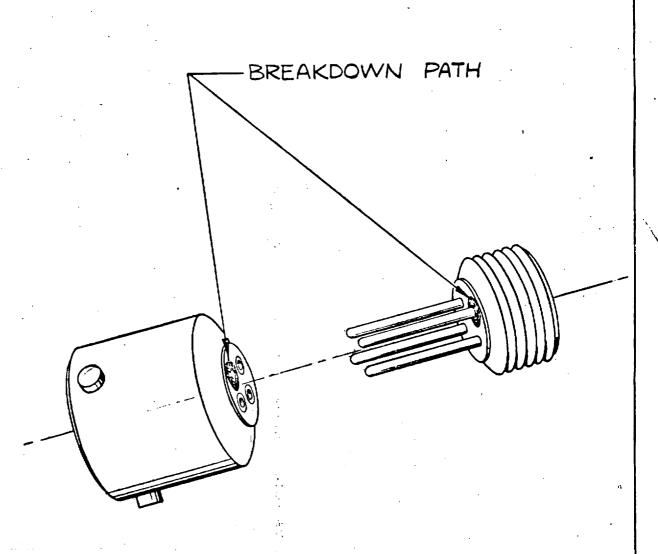
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ADS ATTACHED ACCORDING TO TEST MODE THAT IS PINA, NS A TOB AND PINS A TOC.

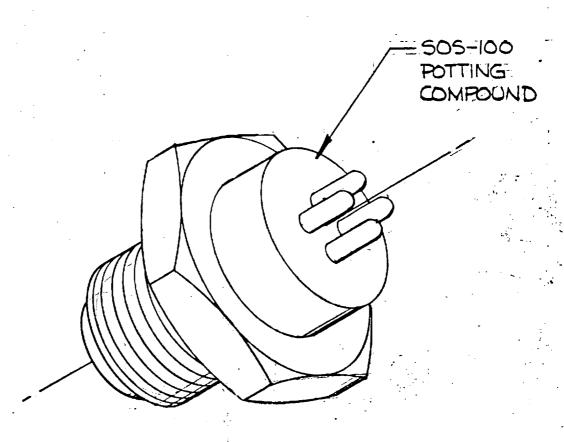
MODE TEST ILLUSTRATION

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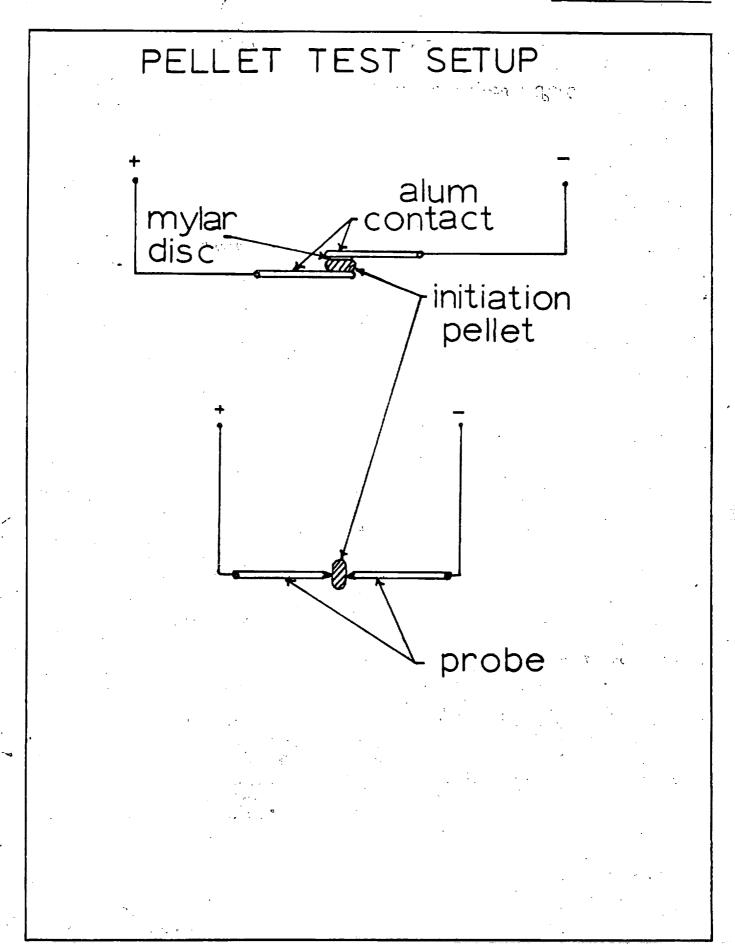


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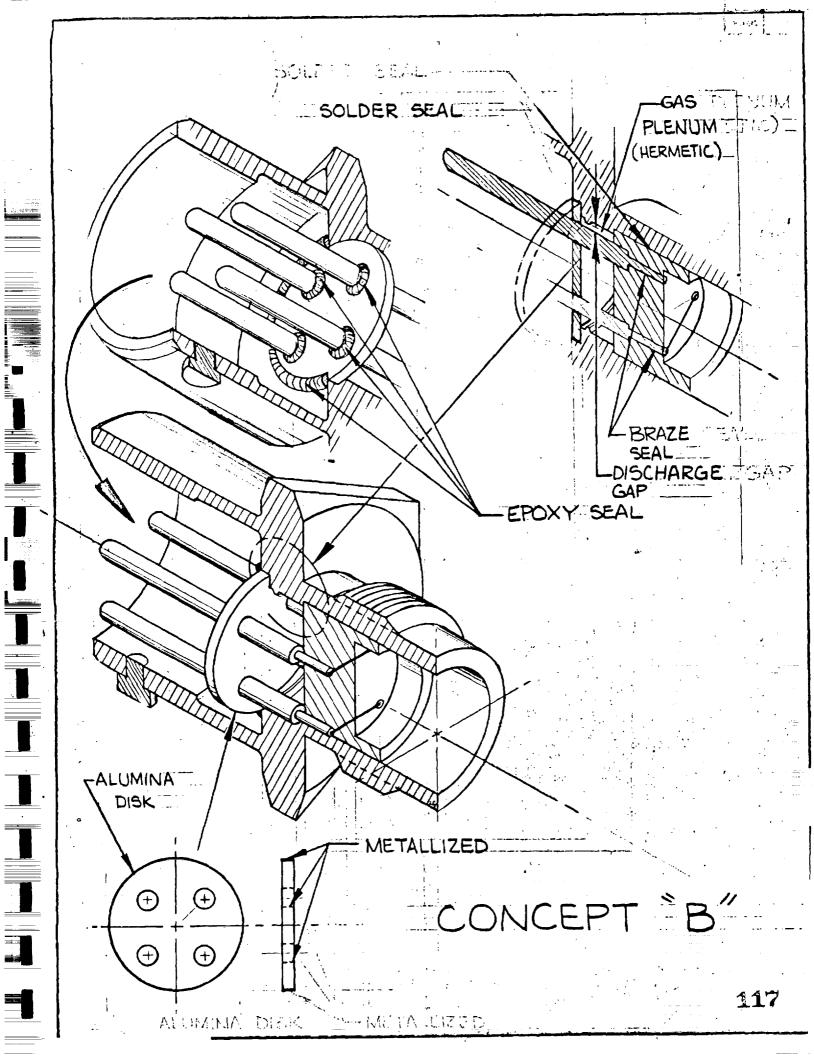
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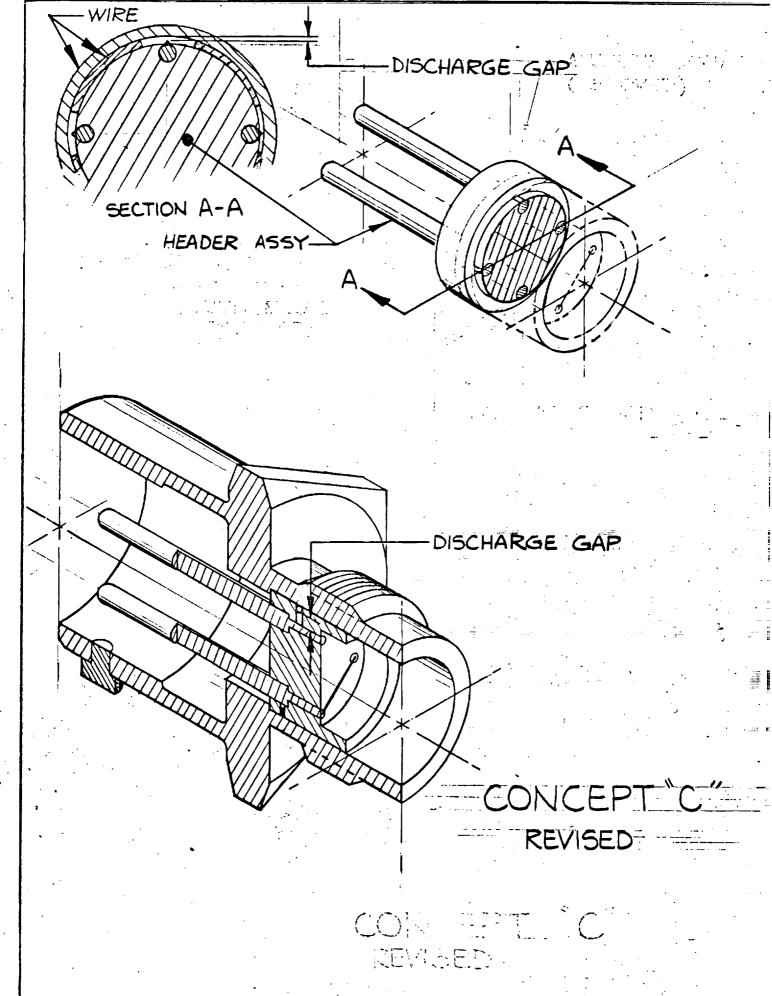


MODIFIED CONCEPT CONFIGURATION

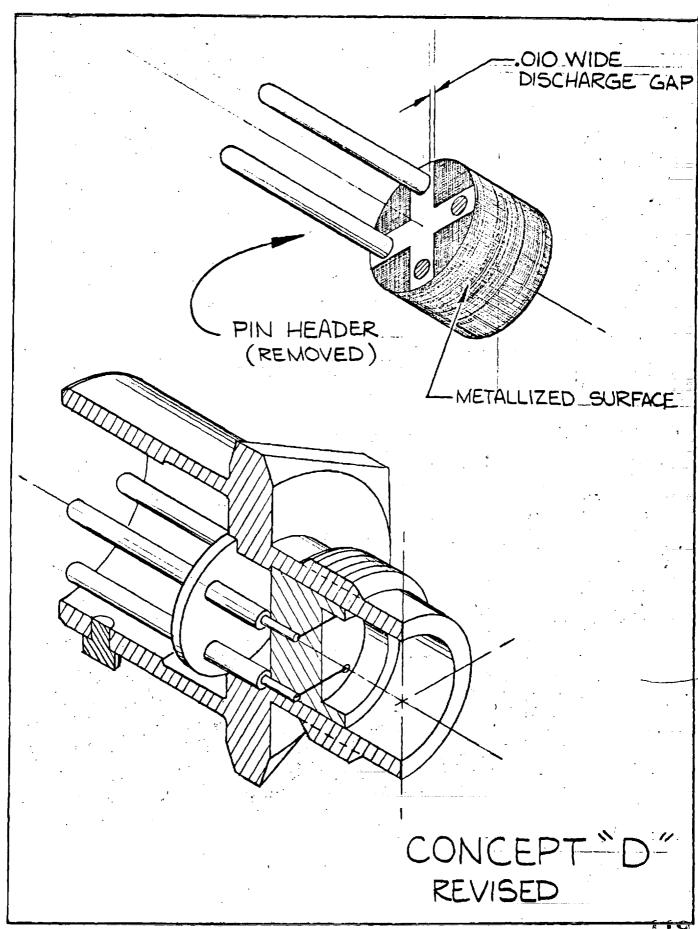


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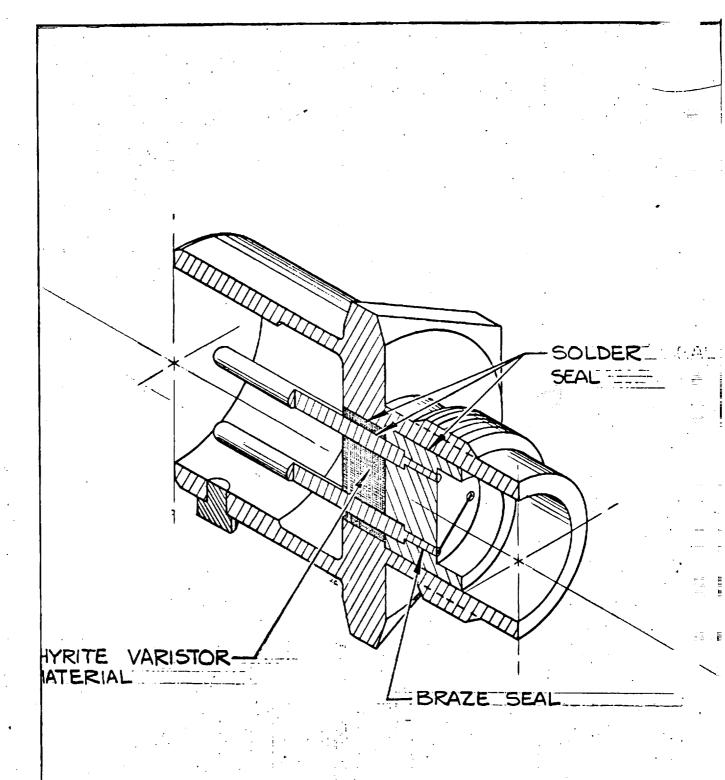


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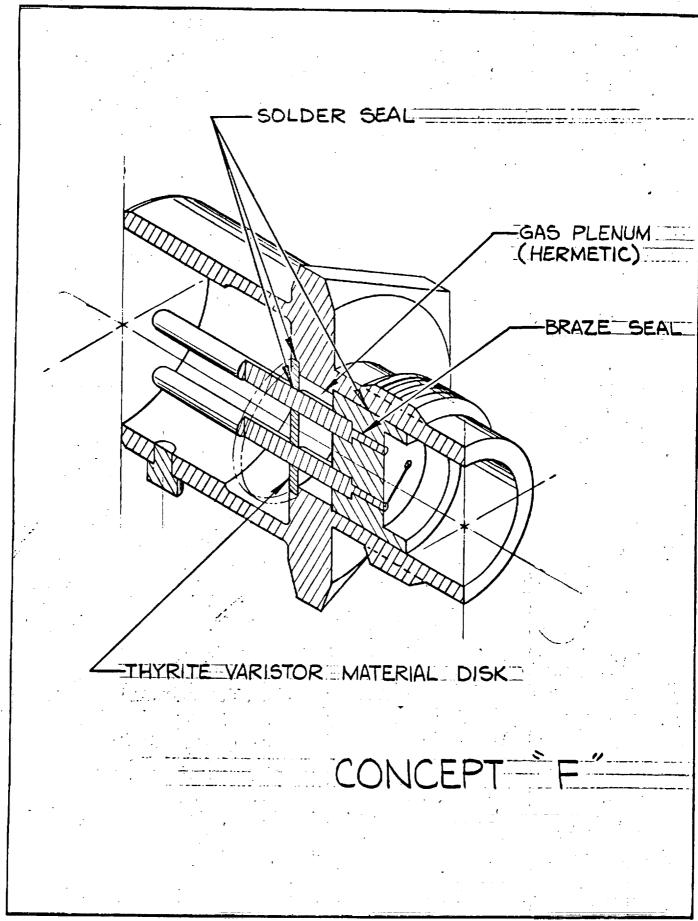


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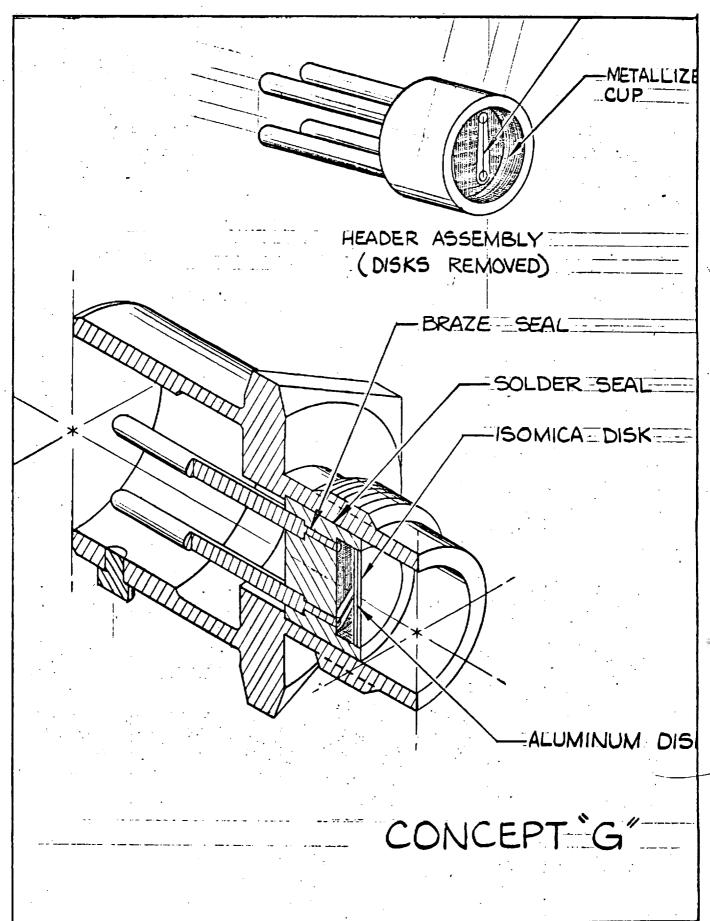
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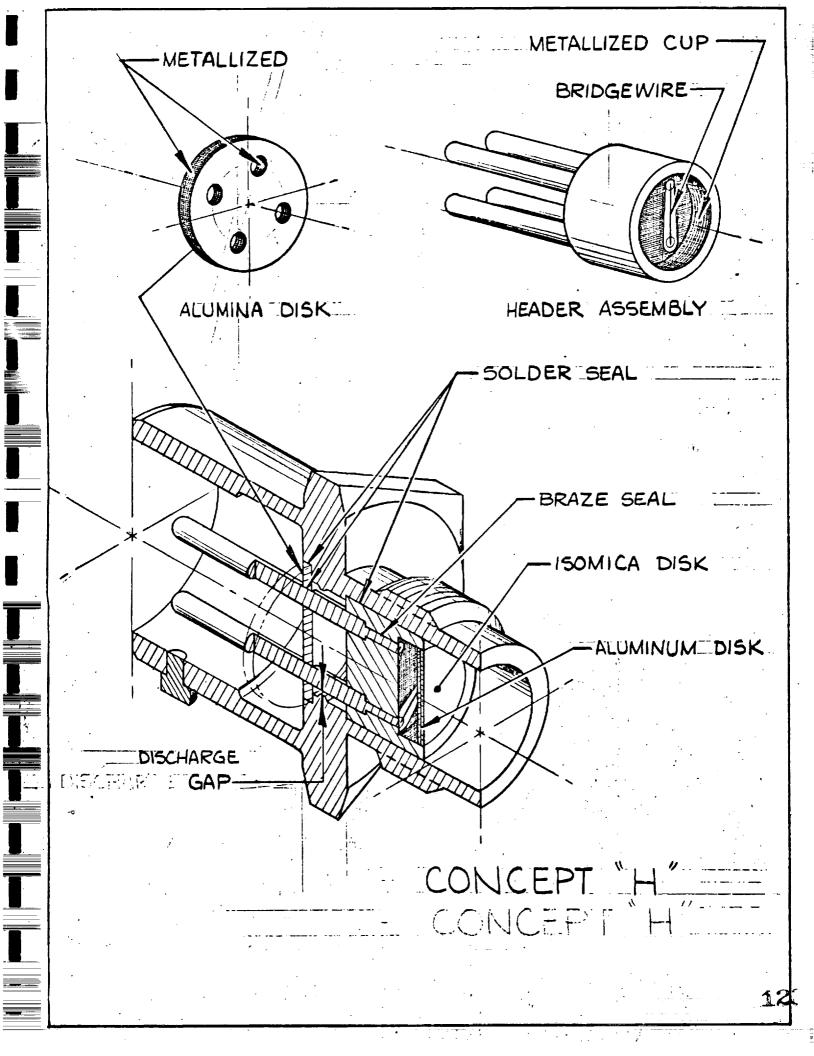


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